SOIL SURVEY

South Umpqua Area Oregon

UNITED STATES DEPARTMENT OF AGRICULTURE
Forest Service
and
Soil Conservation Service
In cooperation with
OREGON AGRICULTURAL EXPERIMENT STATION
Issued April 1973

Major fieldwork for this survey was done in the period 1957-60. Soil names and descriptions were approved in 1966. Unless otherwise indicated, statements in the publication refer to conditions in the survey area in 1957-60. This survey was made cooperatively by the Forest Service, the Soil Conservation Service, and the Oregon Agricultural Experiment Station to gather information needed for managing lands of the Umpqua National Forest. It is part of the technical assistance furnished to the South Umpqua Ranger District. (At the time of the survey, the survey area was not in a Soil and Water Conservation District. It was made a part of the South Douglas Soil and Water Conservation District in 1970.)

Either enlarged or reduced copies of the soil map in this publication can be made by commercial photographers, or they can be purchased on individual order from the Cartographic Division, Soil Conservation Service, United States Department of Agriculture, Washington, D.C. 20250.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY of the South Umpqua Area was made to obtain basic information that would aid in planning multiple-use management. Among the objectives of such management are to check soil deterioration, to increase sustained yields of water, to improve yields of timber and herbage, to improve the habitat for wildlife, to increase the value of the survey area for recreation, and to aid in locating and building roads and trails.

Locating Soils

All the soils of South Umpqua Area are shown on the detailed map at the back of this publication. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbols. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information. This guide lists all the soils of the county in alphabetic order by map symbol. It also shows the page where each soil is described and the page for the soil management group and the capability subclass in which the soil has been placed.

Individual colored maps showing the relative suitability or degree of limitation of soils for many specific purposes can be developed by using the soil map and the information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Foresters and others can refer to the section "Soil Management Groups," where the soils of the survey area are grouped according to their suitability for trees.

Game managers, sportsmen, and others can find information about soils and wildlife in the sections "Wildlife" and "Use of Soils as Wildlife Habitat."

Engineers and builders can find, under "Engineering Uses of the Soils," tables that contain test data, estimates of soil properties, and information about soil features that affect engineering practices.

Scientists and others can read about how the soils formed and how they are classified in the section "Formation, Morphology, and Classification of Soils."

Newcomers in the South Umpqua Area may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the information about the county given at the beginning of the publication.

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BY ELLSWORTH M. RICHLEN

FIELDWORK BY ELLSWORTH M. RICHLEN AND FREEMAN R. STEPHENS, FOREST SERVICE

UNITED STATES DEPARTMENT OF AGRICULTURE, FOREST SERVICE AND SOIL CONSERVATION SERVICE, IN COOPERATION WITH THE OREGON AGRICULTURAL EXPERIMENT STATION

THE SOUTH UMPQUA AREA, in the eastern part of Douglas County (fig. 1), lies within the Umpqua National Forest in the southwestern part of Oregon. This area is about 60 miles southeast of Roseburg, 60 miles north of Medford, and 30 miles east of Canonville. It extends from approximately 42°55′ north to 43°12′ north latitude and from approximately 122°25′ west to 122°57′ west longitude.

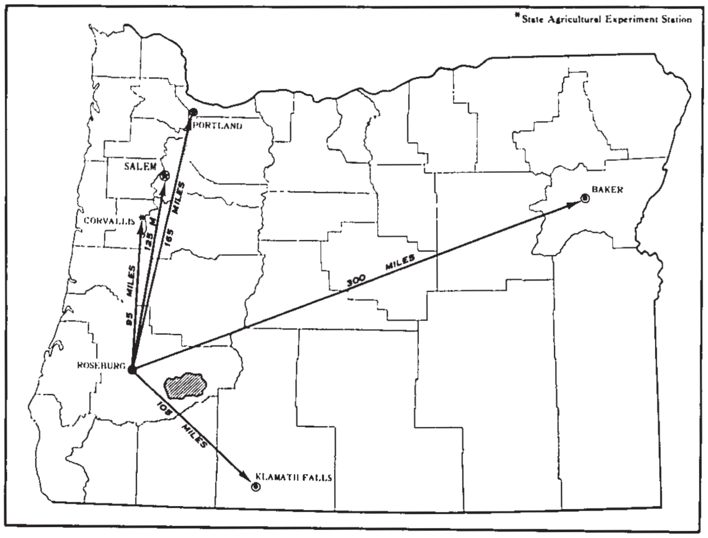

Figure 1.—Location of the South Umpqua Area in Oregon.

The survey area occupies 197,254 acres. It includes the South Umpqua River basin above the mouth of Jackson Creek and the north half of the Jackson Creek drainage. Included is all of the South Umpqua Ranger District and a part of the Cow Creek District. Less than 1 percent of the survey area is in private ownership; the rest is Federal land.

Part I: The Landscape

The landscape of the South Umpqua Area is characterized by mountainous terrain. Its most prominent features are steep, high slopes, swift-flowing streams, and many small waterfalls and rapids. The following pages give some information about the landscape, geology, landforms, and drainage of the South Umpqua Area, as well as general information about the climate, vegetation, wildlife, man's use of the land, and other factors closely related to the pattern of the landscape.

Geology

The soils are closely related to the composition of the bedrock and shape of the landscape. Soil characteristics such as color, texture, and thickness are directly influenced by the nature of the bedrock. For example, soils forming in materials weathered from the reddish breccia have a reddish color. Those forming in materials weathered from greenish breccia have a greenish cast. Soils having the same percentage of slope may be thick or thin depending upon the resistance of the bedrock to weathering.

The rocks, which are almost wholly volcanic, are tuff, breccia, agglomerate, rhyolite, basalt, and andesite flows. Each of these may contain small intrusions of basalt, andesite, and other igneous rocks. Ages of these rocks are believed to range from Eocene (40 to 60 million years ago) to Miocene (10 to 25 million years ago), although most of the flows probably erupted in Miocene time (*2*).[1] Some time in the late Miocene, the area was deformed by tilting, broad folding, and minor faulting to produce a complex rock pattern.

Minor local glaciation has occurred at high elevations, probably during the late Pleistocene (*19*).

Mt. Mazama, now known as Crater Lake, located to the southeast of the survey area, spewed out pumice about 6,500 years ago (*2*). This airborne pumice blanketed the eastern and southeastern parts of the South Umpqua Area. Most of this pumice was later washed from the uplands and deposited along the streams, and now these deposits are in terrace positions. Some areas on uplands in the eastern and southeastern parts of the South Umpqua Area still have a mantle of pumice.

Figure 2 shows the distribution of bedrock in the survey area and the locations of many small basic igneous intrusions. The intrusions are most common in the greenish tuff and breccia and are less extensive in the reddish tuff and breccia. Near the point of contact between the basalt intrusion and green breccia are pieces of petrified wood, as well as jasper and low quality jade. Three broad

[1] Italic numbers in parentheses refer to Literature Cited, p. 59.

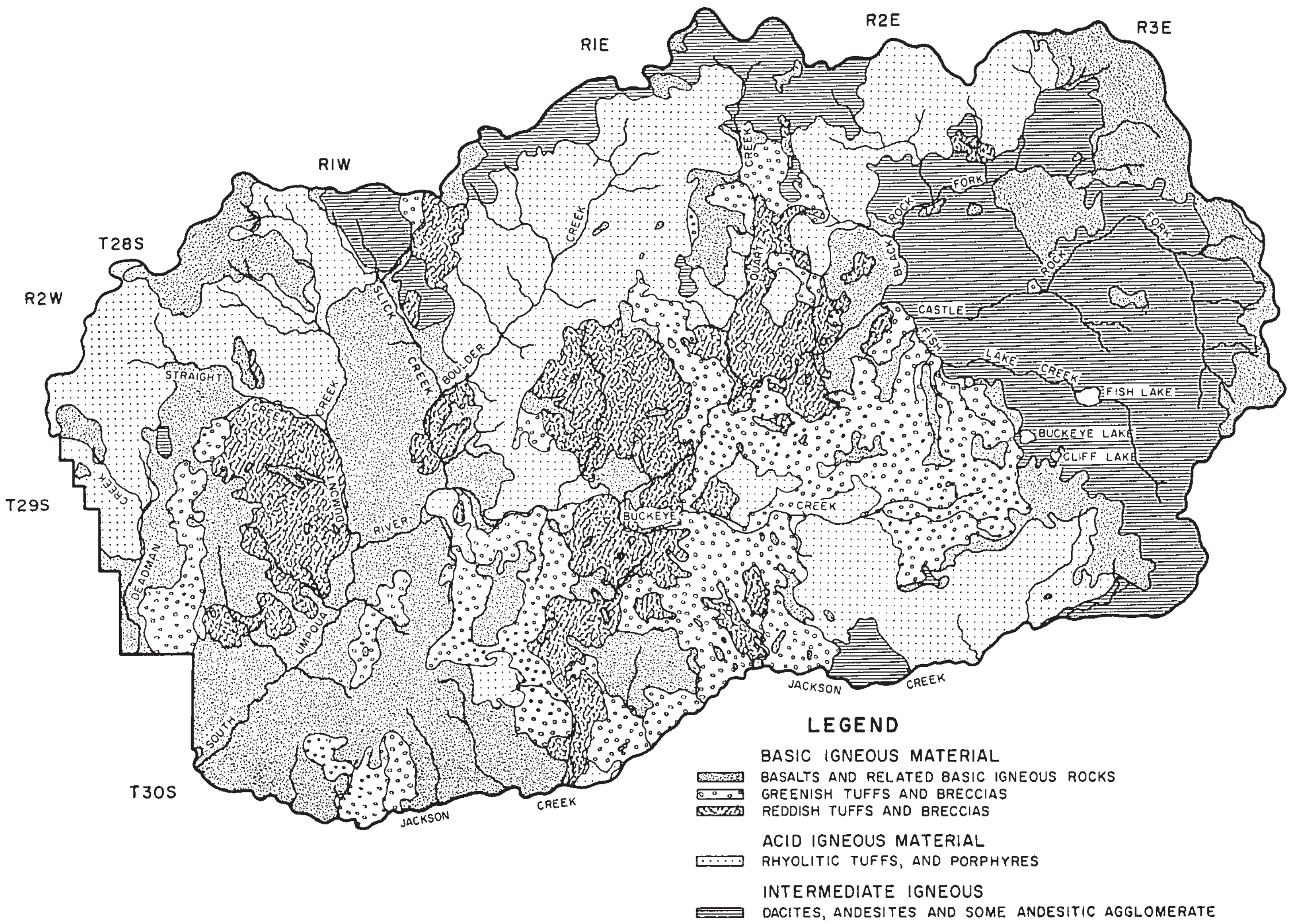

***Figure 2.*—Distribution of bedrock in the South Umpqua Area.**

groups of bedrock material were identified. Three subgroups were made in the group consisting of basic igneous material. The groups and subgroups are as follows:

1. Basic igneous material:
   a. Basalt and other related basic igneous rocks.
   b. Greenish tuff and breccia.
   c. Reddish tuff and breccia.
2. Acid igneous material:
   Rhyolitic tuff, breccia, and porphyry.
3. Intermediate igneous material:
   Dacite, andesite, and some andesitic agglomerate.

Except for the tuff, breccia, and agglomerate, which vary in degree of hardness, all the rocks are hard and resistant to weathering. Their resistance to weathering is one reason that the gently sloping to moderately steep soils are generally shallow and stony. A wide variety of minerals is present, the dominant ones being quartz, orthoclase feldspar, and plagioclase feldspar with lesser amounts of olivine, pyroxene, amphibole, and other minor minerals.

Landforms

The Western Cascades is a maturely dissected region of narrow steep-walled ridges and valleys in which streams form a dendritic pattern (*4*). The South Umpqua Area is in the southern part of the Western Cascades. Steep, high mountain slopes are the most prominent features of the landscape. The ridgetops range from very narrow in the Boulder Creek area and on Rocky Ridge to broad and rounded in the divide between the South Umpqua River and Jackson Creek. Valleys are V-shaped except in the lower reaches of Ash Creek and in the upper reaches of Castle Rock, Buckeye, and Lonewoman Creeks. The streams have a steep gradient and are broken by many small waterfalls and rapids.

The landscape of the South Umpqua Area has been classified into broad segments called landforms. Some of the landforms are shown in figure 3. They are defined as follows:

Dissected slope.—A dissected slope is an inclined surface in uplands incised by relatively shallow, nearly parallel side drainageways that flow perpen-

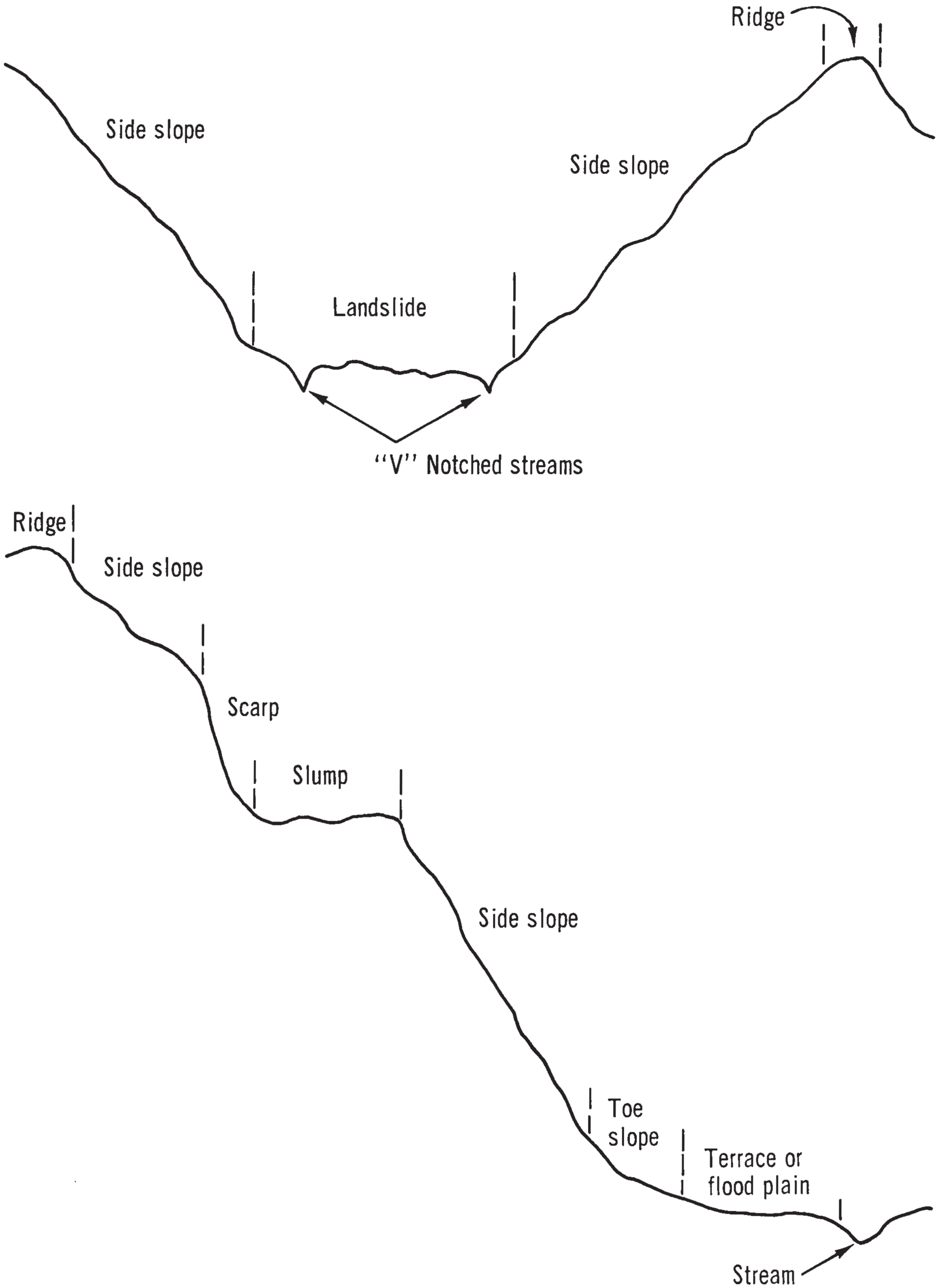

Figure 3.—Diagram of some landforms in the South Umpqua Area.

dicular to the main valley. The drainageways are separated by a ridge that slopes downward.

Landslide.—A mass of wet land moved downslope chiefly by gravity. It is generally characterized by hummocky, irregular microrelief, small marshy areas, parallel stream drainageways, and a discontinuity with the adjacent slopes. Most landslides can be traced to a scarp at their upper end.

Ridge.—A convex surface at high elevation between steeper slopes at lower elevations.

Slump.—A mass of land, lying beneath a scarp, that is nearly level but has uneven surface, commonly characterized by backward tilting of the material. Marshy areas are common in the slight depressions.

Scarp.—A very steep slope having a somewhat cirquelike or semicircular shape above a landslide or slump.

Toe slope.—An alluvial-colluvial deposit at the base of a steep slope.

The South Umpqua Area has a relatively unstable landscape that is characterized by numerous scarps, slumps, and landslides. These unstable areas generally are associated with tuff and breccia rocks. Scarps and slumps occur throughout the Area. For example, half a mile off the main South Umpqua Road along Zinc Creek Road (in Clearcut Unit 2) is a striking example of a scarp and a slump.

The largest and most active landslide is in the Lonewoman Creek drainage in the upper Jackson Creek area. The landslide contains four small lakes, a number of small marshes, some recent slides, and numerous leaning and broken trees. The streams are cutting sharp V-notches so rapidly that vegetation is sparse on the streambanks.

Fish Lake was formed by a gigantic landslide into Fish Lake Creek. This slide originated on the northwest side of Grasshopper Mountain. The sharp escarpment on Grasshopper Mountain and the similarity of the material in the slides to that in the mountain is evidence of the source of material in the slide. It moved across Fish Lake Creek and deposited agglomerate rocks on top of the andesite on the steeper slopes to the north of Fish Lake Creek. It is possible that prior to the slide, Fish Lake Creek was south of its present location. The stream now flows over hard andesite bedrock and forms numerous waterfalls before reaching its original stream gradient. Buckeye Lake and Cliff Lake have formed since the original movement.

Another example of a large land movement is the Ash Creek drainage area. Ash Creek was blocked just above its confluence with the South Umpqua River by a slide which moved in a southeasterly direction and created a small lake that has since filled with sediment. This slide moved the stream channel eastward and formed a small waterfall. Approximately 2 miles off the main South Umpqua Road on Camp Vena Road is an escarpment which appears to be the origin of the slide.

Glaciation has modified the topography at the highest elevations in the eastern part of the survey area, from the vicinity of Black Rock Mountain to the area south of Hershberger Mountain. To the east and just outside the South Umpqua Area, glaciation has had the greatest influence in modifying the topography. Cirques are prominent near Black Rock, Fish, Weaver, Jackass, and Hershberger Mountains. The cirque headwalls are very steep, rocky, and sparsely vegetated. The cirque basins contain small marshes and numerous springs and generally are covered with volcanic ash.

The upper part of Castle Rock Fork, which flows in a northwesterly direction, was glaciated. A small terminal moraine is about a mile upstream from the point where the streamflow changes from a northwesterly direction to a southwesterly direction. The stream valley is U-shaped in the part that flows northwest and V-shaped in the part that flows southwest.

Pumice from Mt. Mazama has modified the landscape in the eastern and southeastern parts of the survey area. The nearly level to very gently sloping areas generally have a pumice mantle that tends to smooth out what was once a more rugged landscape. These thickly pumice-mantled areas store large quantities of water and release it slowly, and give streams in the area a uniform sustained flow. Terraces of pumice are common along streams that originate on the south and east sides of the main South Umpqua River and Jackson Creek. Thick deposits of pumice lie along both Jackson Creek and the South Umpqua River. Pumice does not occur along streams that originate to the north of the South Umpqua River, such as Quartz, Ash, Slick, Boulder, Dumont, and Straight Creeks.

The highest elevation in the survey area, 6,783 feet, is on Hershberger Mountain, which lies at the upper end of Lonewoman Creek. Other high mountain peaks are Rattlesnake, 6,656 feet; Black, 6,150 feet; and Grasshopper, 5,522 feet. Almost half of the survey area is below 3,000 feet, and less than 5 percent of the survey area is above 5,000 feet. The lowest elevation is about 1,500 feet.

Drainage of the South Umpqua Area

The South Umpqua River flows in a southwesterly direction. The tributaries form a dendritic pattern. Streams that flow from the north and to the east of the South Umpqua River are much longer than those that flow from the south.

Peak runoff usually occurs early in spring after a heavy thunderstorm or after a rapid rise in temperature that accelerates the snow melt at the high elevations. The low available water capacity of the soils causes a low sustained water yield in the drier summer months; consequently, the South Umpqua River has a highly variable streamflow. Numerous perennial streams that also have highly variable streamflow drain into the South Umpqua River.

Most stream channels formed over long periods of time. They are the combined result of geology and climate and are strongly influenced by vegetation. Recent land-use practices can be evaluated by studying the stream channels. The number and frequency of stream channels are an index to water behavior.

The highest drainage density patterns are in areas of shallow soils that have steep slopes. In areas that have dense drainage patterns, the soils have low water-storage capacity and runoff is rapid. The water concentrates in numerous drainage channels and causes rapid rises in the streams and flash floods. Boulder, Last, Slick, Boze, and Castle Rock Creeks and the upper reaches of Straight Creek have a high drainage density pattern.

Streams that have a low drainage density pattern are surrounded by deep, permeable soils that have gentle slopes and high water capacity. Examples of streams that have low drainage density patterns are Francis and Lonewoman Creeks and the upper third of Buckeye Creek.

Raw stream channels and deep gullies are not common. Raw stream channels are mostly in landslide areas, especially where land movement has been recent. An example of raw stream channels is in the Lonewoman Creek drainage.

Six lakes are in the survey area. They cover about 125 acres. All formed as the result of large mass movements of land. These lakes generally are deep and provide excellent trout fishing. Several small ponds and marshes have been formed by beaver dams. These ponds are shallow, but some of them offer excellent trout fishing.

Additional information about drainage patterns and the use and control of water resources in the survey area is given in the section "Water Behavior and Management."

Climate

The South Umpqua Area has a modified marine climate because of the proximity of the Pacific Ocean and prevalence of southwesterly winds. No weather data have been recorded within or near the survey area.

Precipitation varies considerably throughout the survey area because of the complex topography and irregular storm patterns. Generally, precipitation increases with increasing elevation, but exceptions exist due to wind and storm patterns. It is estimated that the annual precipitation ranges from 40 inches at elevations below 2,500 feet to 70 inches at the highest elevations (*13*). Most of the precipitation falls between late in September and early in June. Less than 1 inch of rainfall per month falls in July and August. Little snow falls below 3,000 feet elevation. Rainfall intensities of 1.6 inches per hour can be expected for a period of 15 minutes at intervals of 25 years (*18*).

Temperature, like precipitation, varies according to the complexity of topography and the irregular storm patterns. North-facing slopes are nearly always cooler than the adjacent south-facing slopes, and temperatures decrease with increasing elevation. The summer daytime temperatures decrease with increasing elevation. The summer daytime temperatures are often warm (as high as 90°F.), whereas summer temperatures at night are cool. Average temperature in January ranges from 28° F. to 32° F. and average temperature in July ranges from 60° F. to 66° F. (*13*). Microclimate varies widely.

The annual frost-free season ranges from 40 days at the highest elevations to as much as 120 days at the lowest elevations (*13*). At high elevations frost can occur in any month. Topography and aspect greatly influence the length of the frost-free season.

Vegetation

The South Umpqua Area lies in a transition zone between the Douglas-fir forests to the north and the mixed pine forests to the south. The vegetation consists of many kinds of trees, shrubs, grasses, forbs, ferns, mosses, and fungi that provide wildlife forage.

The survey area is dominantly covered by a coniferous forest that has small openings that resemble meadows. The meadow openings are most numerous at elevations above 4,000 feet. Douglas-fir, sugar pine, and ponderosa pine make up the bulk of the commercial timber in this Area. Also present are noble and Shasta red fir, western white pine, incense-cedar, western redcedar, western hemlock, western yew, and a number of hardwood species.

Scattered throughout the Area at elevations above 4,000 feet are Alaska-cedar, lodgepole pine, and knobcone pine. The dominant species at the higher elevations are Douglas-fir, incense-cedar, western white pine, Shasta red fir, noble fir, silver fir, and mountain hemlock.

At elevations below 4,000 feet, the dominant species are Douglas-fir, sugar pine, ponderosa pine, incense-cedar, and to a lesser extent, white fir, grand fir, and western yew.

Wildlife has been an important ecological factor. In most of the survey area the forest has burned sometime during the past 1,000 years. Charcoal can be found in nearly all the soils. Burns have occurred within the past 50 years throughout the Prong, Boze, and French Creek drainages, as evidenced by the young timber stands, burned and charred logs, and large fields of brush.

Following are the scientific and common names of the principal native and exotic plants in the survey area:

TREES

Scientific name	*Local common name*
Abies concolor	White fir
Abies grandis	Grand fir
Abies magnifica (var. *shastensis*)	Shasta red fir
Abies procera	Noble fir
Acer macrophyllum	Bigleaf maple
Arbutus menziesii	Madrone
Castanopsis chrysophylla	Chinquapin
Chamaecyparis nootkatensis	Alaska-cedar
Cornus nuttallii	Pacific dogwood
Fraxinus latifolia	Oregon ash
Libocedrus decurrens	Incense-cedar
Pinus attenuata	Knobcone pine
Pinus contorta	Lodgepole pine
Pinus lambertiana	Sugar pine
Pinus monticola	Western white pine
Pinus ponderosa	Ponderosa pine
Pseudotsuga menziesii	Douglas-fir
Quercus garryana	Oregon white oak
Taxus brevifolia	Pacific yew
Thuja plicata	Western redcedar
Tsuga heterophylla	Western hemlock
Tsuga mertensiana	Mountain hemlock

SHRUBS

Acer circinatum	Vine maple
Amelanchier florida	Pacific serviceberry
Arctostaphylos spp	Manzanita
Berberis aquifolium	Oregon-grape (shiny)
Berberis nervosa	Oregon-grape (dull)
Ceanothus integerrimus	Deer brush
Ceanothus prostratus	Squawcarpet
Ceanothus velutinus	Snowbrush
Chimaphila umbellata	Prince's pine or Pipsissewa
Corylus cornuta (var. *californica*)	California hazel
Gaultheria shallon	Salal
Holodiscus discolor	Oceanspray (Creambush rock spirea)
Iris spp	Iris
Linnaea borealis	Twinflower
Rhododendron californicum	Rhododendron or California rosebay
Ribes spp	Currant or gooseberry
Rosa spp	Wild rose

SHRUBS—Continued

Scientific name	*Local common name*
Rubus marcropetalus	Trailing blackberry
Rubus parviflorus	Western thimbleberry
Rubus spectabilis	Salmonberry
Salix spp	Willow
Sambucus caerulea	Blueberry elder
Sorbus cascadensis	Cascade Mountain ash
Symphoricarpos albus	Snowberry
Rhus diversiloba	Pacific poison-oak
Vaccinium parvifolium	Tall red huckleberry

FORBS AND GRASSES

Achlys triphylla	Vanillaleaf (deerfoot V.)
Bromus carinatus	Mountain brome
Broyophyta spp	Mosses
Calypso bulbosa	Calypso (ladyslipper)
Epilobium angustifolium	Fireweed
Fragaria spp	Wild strawberry
Juncus spp	Rush
Koeleria cristata	Prairie junegrass
Lupinus spp	Lupines
Mertensia spp	Bluebells
Polystichum munitum	Western swordfern
Pteridium aquilinum	Western brackenfern
Taraxacum spp	Dandelion
Trientalis latifolia	Western starflower
Trifolium spp	Clover
Trillium ovatum	Pacific trillium
Whipplea modesta	Modest whipplea (whipple vine) or Yerba de selva
Xerophyllum tenax	Common beargrass

Wildlife

Big game animals, smaller mammals, birds, and a few reptiles live in the South Umpqua Area. Trout thrive in all streams, beaver ponds, and lakes. Steelhead, chinook, and silver salmon spawn in the main South Umpqua River, in Jackson Creek, and in their tributaries.

Columbia black-tailed deer are the most numerous of the big game animals. It is estimated that the deer population within the survey area is more than 12 per square mile, or about 3,500. Woody shrubs are the primary food for deer during fall and winter and forbs and grasses during spring and summer. Early in spring many deer migrate to higher elevations where the timber is more open and numerous shrubs grow along the borders of mountain meadows. Late in fall deep snow forces their return to areas at elevations below 3,000 feet. In spring after fawning it is common to see many fawns along the roadsides.

The black bear is shy and rarely seen. Numerous signs of bear are found along the streams and trails and in huckleberry patches. Timber crews often return to camp on Monday morning after being away for a weekend to find that their camp has been destroyed by bears.

Mink, marten, muskrat, raccoon, bobcat, and coyote are the main small fur-bearing mammals. Mink, raccoon, and muskrat live along the streams, beaver ponds, and lakes. Bobcats and coyote roam throughout the survey area.

Brush rabbits live in the more dense brushy areas at lower elevations. Rock rabbits (Cascade Pika) live at the higher elevations in rock slides and rock outcrops. The noise they make breaking the mountain silence and their "haystacking" of vegetation for curing for winter and summer feeding are unique. Small piles of vegetation (grasses, sedges, weeds, flowers, woody plants) can be seen close to their homes.

Squirrels and other rodents are numerous; they feed mostly on the seeds of conifers. Porcupines are most common in young stands of ponderosa pine. They are more numerous in the Jackson Creek drainage than in the South Umpqua River drainage.

Beaver are common in all streams and lakes. The headwaters of Lonewoman Creek contain a number of beaver dams. Beaver have also dammed up a number of small streams to form ponds several acres in size. Their primary requirements are water, a food supply consisting largely of shrubs, and streams that have a low gradient. The Beaver Swamp near Fish Lake is an excellent trout fishing area.

Mountain lions are in the South Umpqua Area and in adjacent mountainous areas. They live at the higher elevations. Only occasionally is evidence of mountain lions found, and these predators are rarely seen. Deer are abundant in the high mountain areas and provide food for the mountain lion.

Game birds in the survey area include blue grouse, ruffed grouse, mountain quail, and band-tailed pigeon. Blue grouse live throughout timbered areas, but ruffed grouse live mainly along stream bottoms. Mountain quail are more numerous in cutover areas or along the borders of meadows at the lower elevations. Band-tailed pigeons are most numerous in cutover areas late in fall when the elderberries are ripe.

Scavenger birds in the survey area include ravens, crows, and turkey vultures. There are numerous songbirds and hawks. Ducks and a few geese are along the major streams, lakes, and beaver ponds. Some waterfowl nest near the beaver ponds.

Rattlesnakes inhabit areas at lower elevations, usually below 3,000 feet, but they are not common. In recent years they have been reported in the Dumont Creek, Boulder Creek, and Buckeye Creek drainages. Scorpions and nonpoisonous lizards are abundant. The scorpion sting is usually no more serious than a bee sting.

Numerous streams and lakes throughout the survey area contain native cutthroat and stocked rainbow and eastern brook trout. The high mountain lakes have been stocked with rainbow and eastern brook trout and provide excellent fishing. Native cutthroat trout are numerous in the high mountain streams but are usually small.

Additional facts about wildlife are in the section "Use of Soils as Wildlife Habitat."

People and Their Use of the Land

The first inhabitants of the South Umpqua Area were the Umpqua Indians. Their arrowheads, spear points, scrapers, mortars and pestles, and other artifacts have been found throughout the survey area. Most artifacts are found in what were campsites along the streams and near waterfalls. Fishing was evidently an important activity. Obsidian artifacts found in the survey area indicate that trading was carried on with the Indians to the east.

The first white men to pass through the southwestern part of Oregon were trappers of the Hudson Bay Company who traveled through the Canyonville area in 1828. In 1858 a wagon road was built through Canyonville to California, and settlers began to move up the South Umpqua River drainage. As the lower areas were home-

steaded, settlers took up homesteads in the back country, often on natural grassland areas. Some homesteads still exist as islands of private land within the National Forest.

In 1886 part of the survey area was set aside in forest reserves, and the rest was set aside in 1907. In 1907 the Umpqua National Forest was formed from part of the old Cascade National Forest, which included most of southwestern Oregon. The Cow Creek Ranger District was formed in 1954 from the southern part of the South Umpqua Ranger District.

During and since World War II, demands for timber resulted in the development of an access road system. As a result, gravel roads now provide access to much of the survey area. Improved trails provide access to most of the remainder of the survey area.

The timber industry is the major economic activity, and at present, approximately 50 million board feet of timber is cut annually on a sustained-yield basis. The logs are hauled by trucks to mills within a 50-mile radius.

Recreational use is increasing rapidly and probably will become more important to the local economy in the future. A limited number of livestock graze within the survey area.

Thunderstorms are common in the dry summer months, and lightning starts many fires. In recent years lightning has started an average of about five fires per year. Before the development of a fire control system, fires started by lightning burned until stopped by natural causes. During the period 1932 to 1936 a number of incendiary fires were set. The realization of the value of the timber industry to the local economy has caused this problem to disappear, and intensive fire prevention and control programs have become standard.

Part II: Soils of the South Umpqua Area

This part tells how the survey of the South Umpqua Area was made. It describes the soil associations, the soil series, and the mapping units in the survey area and gives facts about the formation, morphology, and classification of the soils.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in the South Umpqua Area, where they are located, and how they can be used. The soil scientists went into the area knowing they likely would find many soils they had already seen and perhaps some they had not. They observed the steepness, length, and shape of slopes, the size and speed of streams, the kinds of native plants or crops, the kinds of rock, and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by the action of plant roots.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in areas nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The *soil series* and the *soil phase* are the categories of soil classification most used in a local survey.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Acker and Dumont, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface layer and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Acker gravelly loam, 0 to 20 percent slopes, is one of several phases within the Acker series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, trees, and other details that help in drawing boundaries accurately. The soil map in the back of this publication was prepared from the aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil phase.

Some mapping units are made up of soils of different series, or of different phases within one series. One such kind of mapping unit, a soil complex, is shown on the soil map of the South Umpqua Area.

A soil complex consists of areas of two or more soils, so intermingled or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. The name of a soil complex consists of the names of the dominant soils, joined by a hyphen. An example is Crater Lake-Snowlin complex, 10 to 30 percent slopes.

In most areas surveyed there are places where the soil material is so rocky, so shallow, or so severely eroded that it cannot be classified by soil series. These places are shown on the soil map and are described in the survey, but they are called land types and are given descriptive names. Alluvial land is a land type in the South Umpqua Area.

While a soil survey is in progress, samples of soils are taken, as needed, for laboratory measurements and for engineering tests. Laboratory data from the same kinds of soil in other places are assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soil. Yields under defined management are estimated for all the soils. The South Umpqua Area is not used to any extent for farming. Therefore, data on yields

of farm crops were not included in this survey. Included, however, is information about potential yields of wood products.

But only part of a soil survey is done when the soils have been named, described, and delineated on the map, and the laboratory data and yield data have been assembled. The mass of detailed information then needs to be organized in such a way as to be readily useful to different groups of users, among them farmers, managers of woodland and rangeland, and engineers.

On the basis of yield and practice tables and other data, the soil scientists set up trial groups. They test these groups by further study and by consultation with farmers, agronomists, engineers, foresters, and others, then adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under present methods of use and management.

General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in the South Umpqua Area. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in an area, who want to compare different parts of an area, or who want to know the location of large tracts that are suitable for a certain kind of land use. Such a map is a useful general guide in managing a watershed, a wooded tract, or a wildlife area, or in planning engineering works, recreational facilities, and community developments. It is not a suitable map for planning the management of a farm or field, or for selecting the exact location of a road, building, or similar structure, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect their management.

The seven soil associations in the South Umpqua Area are described on the following pages.

1. *Coyata-Freezener-Dumont association*

Soils that have a moderately fine textured and fine textured subsoil; formed over basalt in a warm climatic environment

This soil association is in mountainous areas where slopes range from 0 to 80 percent. The soils formed primarily in material weathered from basic igneous rocks. Elevations range from 1,500 to 4,000 feet. Annual precipitation is 40 to 60 inches. The vegetation is primarily Douglas-fir and sugar pine with lesser amounts of ponderosa pine.

This association occupies about 30 percent of the survey area. Coyata soils make up about 35 percent of this association. Freezener soils make up about 20 percent. Dumont soils make up about 10 percent. Fives, Deatman, Straight, Zing, Crater Lake, and other soils make up the remaining 35 percent.

Coyata soils are well drained and overlie basalt at depths of 20 to 40 inches. The surface layer is gravelly loam, and the subsoil is gravelly and very cobbly clay loam. Freezener soils are well drained and overlie basalt at a depth of more than 40 inches. They have a gravelly loam surface layer and a clay subsoil. Dumont soils are similar except that the subsoil is very strongly acid and overlies basic reddish breccia. Fives soils are olive brown and formed in weathered greenish breccia. Straight soils are very gravelly loams and overlie greenish breccia. Crater Lake soils are on terraces and formed in pumice alluvium. Zing soils are moderately well drained.

This association has a high potential productivity for timber. On the Dumont soils ponderosa pine and sugar pine grow better than Douglas-fir, but on the Freezener soils all of these trees grow about equally well. Coyata soils are better suited to Douglas-fir or sugar pine than to ponderosa pine.

Cover for wildlife is excellent.

The basalt bedrock is an excellent source for road materials (fig. 4), but the breccia bedrock is poor for this purpose.

Most of the soils in this association are easily compacted by campground use.

2. *Straight-Dumont association*

Soils that have a medium-textured and fine-textured subsoil; formed over reddish breccia in a warm climatic environment

This association is in mountainous areas where slopes range from 0 to 80 percent. Some landslides, slumps, and scarps are in this association (fig. 5).

The soils formed primarily in material weathered from reddish breccia. Elevations range from 1,500 to 4,000 feet. Annual precipitation is 40 to 60 inches. The vegetation primarily is Douglas-fir and sugar pine with lesser amounts of ponderosa pine.

This association occupies about 9 percent of the survey area. Straight soils make up about 55 percent of this association. Dumont soils make up about 15 percent. The Vena and Acker soils make up most of the remaining 30 percent. Small tracts of Freezener and Coyata soils also occur.

Straight soils are well-drained very gravelly loam soils that overlie reddish breccia bedrock at depths of 20 to 40 inches. Dumont soils are well drained and overlie reddish breccia at a depth of more than 60 inches. The surface layer is gravelly loam, and the subsoil is clay. Acker and Vena soils overlie rhyolitic bedrock. Freezener and Coyata soils overlie basalt bedrock.

The soils in this association are used for timber and water supply. The Straight soils have low potential productivity for timber. Dumont soils are better suited to sugar pine and ponderosa pine than Douglas-fir. The clay subsoil restricts Douglas-fir roots and causes the roots to mat in the upper part of the soil. Such shallow rooting increases the hazard of windthrow.

Cover for all wildlife is excellent.

The breccia bedrock, which underlies most of the assocation, is poor for road materials. Basalt, another important bedrock, is excellent for this purpose.

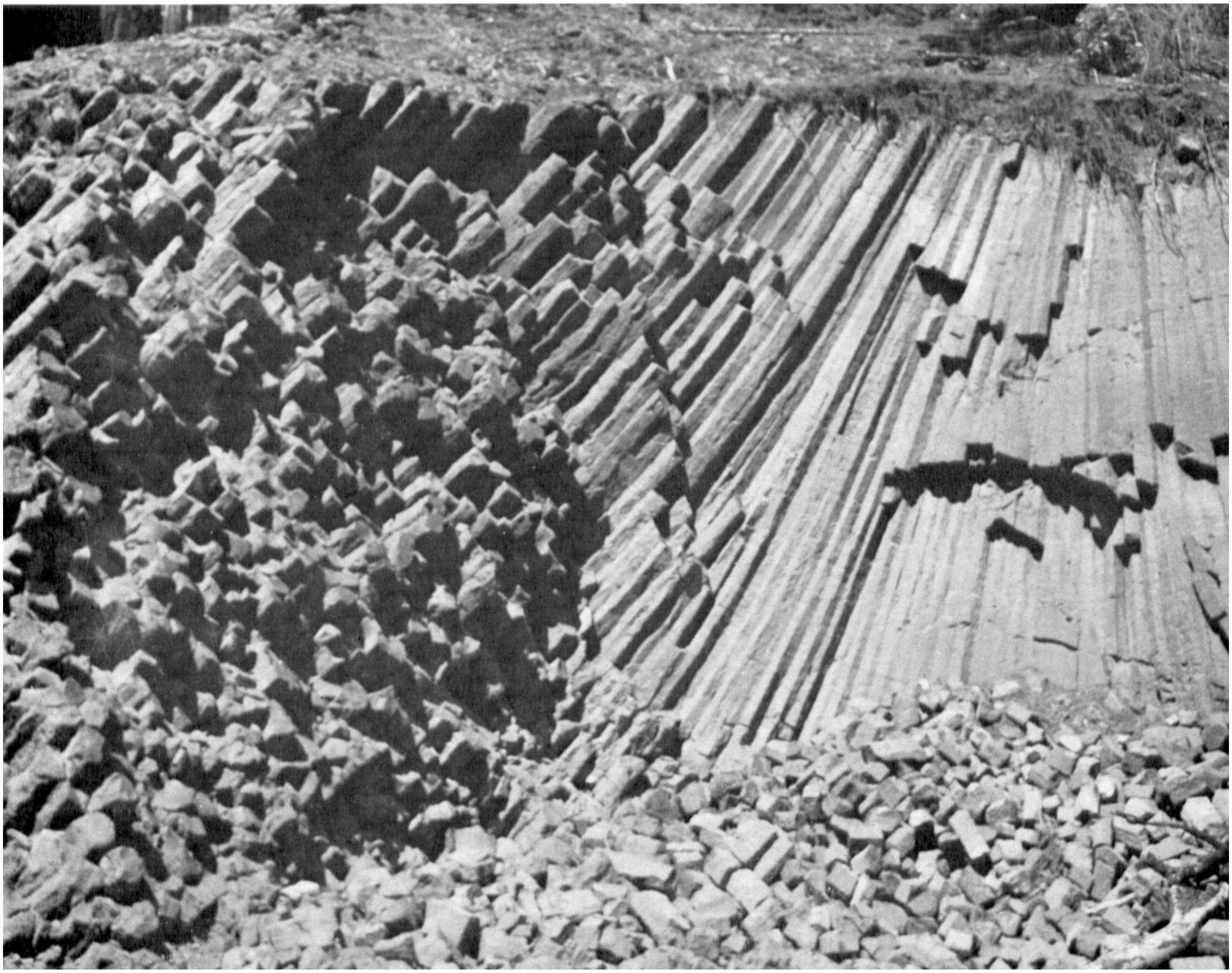

Figure 4.—**Basalt bedrock exposed in an area of Coyata soils of association 1. Crushed basalt is excellent for surfacing roads.**

Most of the soils of this association are easily compacted by campground use.

3. *Fives-Deatman association*

Soils that have a moderately fine textured subsoil; formed over greenish breccia in a warm climatic environment

This association is in mountainous areas where slopes range from 0 to 80 percent in mountainous topography. There are a few landslides, slumps, and scarps. The soils formed primarily in colluvium weathered from greenish breccia. Elevations range from 1,500 to 4,000 feet. Annual precipitation is 40 to 60 inches. The vegetation is primarily Douglas-fir, sugar pine, and ponderosa pine.

This association occupies about 14 percent of the survey area. Fives soils make up about 45 percent of this association. Deatman soils make up 35 percent. The rest is mainly Gustin, Freezener, Coyata, and other soils.

Fives soils are well drained. The surface layer is loam and the subsoil is clay loam. Deatman soils are well drained and overlie greenish breccia bedrock at depths of 20 to 40 inches. The surface layer is gravelly loam, and the subsoil is gravelly sandy clay loam. Gustin soils are moderately well drained. Freezener and Coyata soils overlie basalt bedrock.

The soils in this association are used for timber and water supply. Site indices for Douglas-fir, sugar pine, and ponderosa pine range from high to low.

Cover for all wildlife is excellent. The brush is of low forage value for deer. It generally does not retard tree regeneration.

The breccia bedrock, which underlies most of this association, is poor for road materials. Basalt, another important bedrock, is excellent for this purpose.

Most of the soils of this association are easily compacted by campground use.

Figure 5.—**A landslide, slump, and scarp in association 2. A Freezener soil is in the slump area, and a Coyata soil occupies the scarp.**

4. *Snowlin-Hummington association*

Soils that have a moderately fine textured and medium-textured subsoil that contains volcanic ash; formed over basalt in a cold climatic environment

This association is in mountainous areas where slopes range from 0 to 80 percent. The soils formed primarily in materials weathered from basalt. The upper part of the profile contains variable amounts of ash. Elevations range from 4,000 to 6,000 feet. Soil temperatures are cold and average less than 47°F. annually. Annual precipitation is 50 to 70 inches. The vegetation is primarily Douglas-fir, true fir, western white pine, and western hemlock. Ferns, herbs, and grasses grow in small areas of mountain meadows.

This association occupies about 5 percent of the survey area. Snowlin soils make up about 45 percent of this association. The Hummington soils make up about 35 percent. The rest is mainly Whitehorse, Boze, and Prong soils and Andesite rock land.

Snowlin soils are well drained and overlie basalt at a depth of more than 50 inches. They have a gravelly loam surface layer and a cobbly clay loam subsoil. Hummington soils are well drained and overlie basalt at depths of 20 to 40 inches. They have a gravelly loam surface layer and a very cobbly loam subsoil. Whitehorse soils are in mountain meadows. Boze soils are gravelly loams and overlie dacite tuff, andesite, and diorite. Prong soils are very gravelly sandy loams and overlie tuff, dacite, or andesite.

Except for the Whitehorse soils, which are covered by meadow-type vegetation, the soils are used primarily for timber and water supply. Very few sugar pine and ponderosa pine grow in this association. Douglas-fir is the most common tree. Scattered true fir and western white pine grow in places.

Cover for wildlife is excellent. Deer browse, which is plentiful, is not available in the winter because of the snowpack.

The basalt bedrock is excellent for road surfacing and base materials.

The scenic areas, mostly at the higher elevations, are excellent for recreational uses.

5. *Vena-Acker association*

Soils that have a medium-textured and moderately fine textured subsoil; formed over rhyolitic tuff in a warm climatic environment

This association is in mountainous areas where slopes range from 0 to 100 percent. A few landslides, slumps, and scarps are present. The soils formed primarily in colluvium weathered from rhyolitic tuff. Elevations range from 1,500 to 4,000 feet. Annual precipitation is 40 to 60 inches. The vegetation is primarily Douglas-fir, sugar pine, and ponderosa pine.

This association occupies about 14 percent of the survey area. Vena soils make up about 50 percent of this association, and Acker soils make up about 20 percent. The rest is mainly Boze and Prong soils and Tuff rock land.

Vena soils are well drained and have a very gravelly loam subsoil that overlies rhyolitic tuff at depths of 20 to 40 inches. Acker soils are well drained and overlie rhyolitic tuff at depths of more than 40 inches. They have a clay loam subsoil. Boze and Prong soils are cold and are on north-facing slopes at the higher elevations.

The soils of this association are used primarily for timber and water supply. Douglas-fir, sugar pine, and ponderosa pine are the most common trees. Scattered true fir and western white pine grow in places, mainly in stands of mixed conifers.

Most of the soils of this association produce brush of low forage value for deer.

The underlying bedrock is variable for engineering uses. The rhyolite and dacite tuff are a poor source of material for roads, but the andesite and diorite rock are good for this purpose.

Most of the soils of this association can withstand intensive recreational use.

6. *Prong-Boze association*

Soils that have a moderately coarse textured and medium-textured subsoil; formed over andesite, dacite, and tuff in a cold climatic environment

This association is in mountainous areas where slopes range from 0 to 100 percent. The soils formed primarily in colluvium weathered from andesite, dacite, or tuff. Elevations range from 4,000 to more than 6,000 feet. Annual precipitation is 50 to 70 inches. The vegetation is primarily Douglas-fir, true fir, western hemlock, and some sugar pine.

This association occupies about 15 percent of the survey area. Prong soils make up about 55 percent of this association, and Boze soils make up about 20 percent. The rest is mainly Coyata, Snowlin, and Freezener soils and Andesite rock land.

Prong soils are well drained and overlie bedrock at a depth of 20 to 40 inches. The surface layer is gravelly loam, and the subsoil is very gravelly sandy loam. Boze soils are well-drained gravelly loams more than 40 inches deep over bedrock. Coyata, Freezener, and Snowlin soils overlie basalt bedrock.

The soils in this association are used for timber and water supply. At elevations above 4,000 feet, Douglas-fir is more productive than sugar pine or ponderosa pine, although true fir and western hemlock grow equally well, especially on the north-facing slopes. Very few ponderosa pine and sugar pine trees grow at the higher elevations.

Brush of low forage value to deer is dominant in the understory of timber stands and in cleared areas.

The hazard of erosion generally is severe because of the very steep slopes.

The suitability of the underlying bedrock for engineering uses varies. Basalt is excellent material for roads, but tuff and breccia are poor for this purpose.

The very steep topography limits recreational uses.

7. *Vena association*

Soils less than 40 inches thick that have a medium-textured subsoil; formed over rhyolitic tuff in a warm climatic environment

This association consists of nearly level to very steep soils that are highly dissected. There are a few landslides, slumps, and scarps. A few cirques and cirque basins are at the highest elevations. Slopes are 0 to 100 percent. The soils formed primarily in colluvium weathered from rhyolitic tuff. Elevations range from 1,500 to more than 4,000 feet. Annual precipitation is 40 to 60 inches. The vegetation is mostly Douglas-fir and sugar pine.

This association occupies 13 percent of the survey area. Vena soils make up about 70 percent of the association. The rest is mainly Acker, Prong, and Straight soils and rock land.

Vena soils are well drained. They have a very gravelly loam subsoil and overlie rhyolitic tuff at a depth of 20 to 40 inches. Acker soils have a clay loam subsoil. Prong soils are cold and overlie tuff, dacite, or andesite bedrock. Straight soils overlie reddish breccia bedrock.

Vena soils have the lowest potential productivity for timber in the survey area. They are suited to Douglas-fir and sugar pine, but are not suited to ponderosa pine. Prong soils at elevations above 4,000 feet are suited to true fir and western hemlock, which grow as well as Douglas-fir, especially on the north slopes. Competition from rhododendron, chinquapin, salal, and other brush is a hazard for the establishment of conifers. The hazard of erosion is very severe because slopes are very steep.

Brush of low forage value to deer is dominant in the understory of timber stands and in cleared areas. Brush that provides forage grows at the highest elevations but is usually covered with snow in winter.

The underlying bedrock varies in suitability for engineering uses. Tuff and breccia are poor materials for road construction, but andesite, basalt, and dacite are good for this purpose.

The potential for recreational use is low because many slopes are very steep and the erosion hazard is very severe.

Descriptions of the Soils

This section describes the soil series and mapping units of the South Umpqua Area in alphabetical order. The procedure is first to describe each soil series, and then to describe the mapping units in that series. Thus, to get full information on any mapping unit, it is necessary to read the description of that unit and also the description of the soil series to which it belongs.

The soil series contains a brief description of a soil profile, the major layers from the surface downward. This profile is considered representative for all the soils of the series. If the profile for a given mapping unit differs from this representative profile, the differences are stated in the description of the mapping unit, unless the differences are apparent in the name of the mapping unit.

As mentioned in the section "How This Survey Was Made," not all mapping units are members of a soil series. Alluvial land, for example, does not belong to a soil series, but is listed in alphabetical order along with the soil series.

A technical description representative for the soil series is given under the first mapping unit described for the series. The technical description identifies layers by A, B, and C horizons and depth ranges. These technical descriptions are mainly for soil scientists, engineers, and others who need to make a more thorough and precise study of the soil. The technical profile descriptions, and the paragraph describing range in characteristics that follows, are placed in smaller type than the rest of the description of the soil. Those who want to have only a working knowledge of the soil and its management need only read the part set in larger type.

In describing the representative profile, the color of each horizon is described in words, such as yellowish brown, but it can also be indicated by symbols for the hue, value, and chroma, such as 10YR 5/4. These symbols, called Munsell color notations (*14*), are used by soil scientists to evaluate the color of the soil precisely. For the profiles described, the names of the colors, the color symbols, and the soil consistence are for moist soil unless stated otherwise.

Following the name of each mapping unit, there is a symbol in parentheses. This symbol identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit is the capability subclass and the management group in which the mapping unit has been placed. The page on which each group is described can be found by referring to the "Guide to Mapping Units" at the back of this survey. Many terms in the soil descriptions are defined in the Glossary. The acreage and proportionate extent of the mapping units are shown in table 1. The location of the soils in the South Umpqua Area is shown on the detailed soil map at the back of this survey.

Acker series

The Acker series consists of well-drained gravelly loams that have a clay loam subsoil. Depth to bedrock is more than 40 inches. These soils formed in colluvium and residuum weathered from mainly rhyolitic, acid igneous bedrock. Acker soils are on landslides, toe slopes, and ridges. Slopes range from 0 to 60 percent and are smooth and uneven. Elevations range from 1,500 to more than 4,000 feet. Annual precipitation is 40 to 60 inches. The average annual air temperature is 45° to 50° F., and the frost-free season is 100 to 120 days.

The overstory vegetation is Douglas-fir, sugar pine, and ponderosa pine. The understory is mainly rhododendron and chinquapin.

In a representative profile the surface layer is covered with forest litter and is very dark grayish-brown and dark grayish-brown gravelly loam and loam about 11 inches thick. The subsoil is mainly brown clay loam about 20 inches thick. The substratum above the bedrock is very pale brown loam 19 inches thick. Rhyolitic tuff is at a depth of about 50 inches.

Acker gravelly loam, 20 to 40 percent slopes (AcD).—This soil has smooth, uneven slopes.

Representative profile in NW¼NE¼ sec. 30, T. 28 S., R. 2 E.:

O1—1½ inches to 1 inch, undecomposed twigs, tree limbs, needles, and cones.

O2—1 inch to 0, partly decomposed twigs, tree limbs, needles, and cones.

A1—0 to 6 inches, very dark grayish-brown (10YR 3/2) gravelly loam, light brownish gray (10YR 6/2) when dry; moderate, fine and medium, granular structure; soft when dry, friable when moist, nonsticky and nonplastic when wet; many very fine to coarse roots; many very fine pores; faint light-gray coatings on faces of peds; slightly acid (pH 6.1); clear, wavy boundary. (4 to 9 inches thick)

A3—6 to 11 inches, dark grayish-brown (10YR 4/2) loam, light gray (10YR 7/2) when dry; weak and moderate, medium, granular structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; many very fine to coarse roots; many very fine pores; distinct clean sand grains on faces of peds; medium acid (pH 5.8); clear, wavy boundary. (4 to 7 inches thick)

B1—11 to 16 inches, brown (10YR 5/3) heavy loam, very pale brown (10YR 7/3) when dry; weak or moderate, very fine and fine, subangular blocky structure; slightly hard when dry; friable and firm when moist, slightly sticky and slightly plastic when wet; many very fine to coarse roots; common very fine pores; strongly acid (pH 5.5); clear, wavy boundary. (0 to 20 inches thick)

B2t—16 to 23 inches, brown (10YR 5/3) clay loam, very pale brown (10YR 7/3) when dry; moderate, fine and medium, subangular blocky structure; hard when dry; firm when moist, sticky and plastic when wet; few fine roots; common very fine pores; few thin clay films on peds and in root channels; strongly acid (pH 5.3); gradual, wavy boundary. (4 to 10 inches thick)

B3—23 to 31 inches, yellowish-brown (10YR 5/4) clay loam, very pale brown (10YR 7/3) when dry; moderate, medium and coarse, subangular blocky structure; hard when dry, firm when moist, sticky and plastic when wet; few fine roots; common very fine pores; few thin clay films on peds and in root channels; strongly acid (pH 5.1); gradual, wavy boundary. (0 to 13 inches thick)

C1—31 to 40 inches, very pale brown (10YR 7/4) loam, very pale brown (10YR 8/3) when dry; weak, coarse, subangular blocky structure; soft when dry, friable when moist, slightly sticky and slightly plastic when wet; very few fine roots; many very fine pores; few black and reddish-brown stains; 40 percent of matrix is soft, weathered rock; strongly acid (pH 5.1); gradual, wavy boundary. (5 to 15 inches thick)

C2—40 to 50 inches, very pale brown (10YR 7/4) loam, very pale brown (10YR 8/3) when dry; massive; soft when dry, friable when moist, nonsticky and nonplastic when wet; very few fine roots; few black and yellowish-brown stains; very strongly acid (pH 4.7); abrupt, wavy boundary. (5 to 15 inches thick)

Table 1.—*Approximate acreage and proportionate extent of the soils*

Soil	Acreage	Extent
	Acres	*Percent*
Acker gravelly loam, 20 to 40 percent slopes	4, 918	2. 5
Acker gravelly loam, 0 to 20 percent slopes	2, 184	1. 1
Acker gravelly loam, 40 to 60 percent slopes	519	. 3
Alluvial land	4, 450	2. 3
Andesite rock land	6, 299	3. 2
Boze gravelly loam, 20 to 40 percent slopes	5, 944	3. 0
Boze gravelly loam, 0 to 20 percent slopes	1, 934	1. 0
Coyata gravelly loam, 40 to 60 percent slopes	8, 695	4. 4
Coyata gravelly loam, 20 to 40 percent slopes	2, 431	1. 2
Coyata rocky loam, 60 to 80 percent slopes	5, 212	2. 6
Coyata rocky loam, dissected, 60 to 80 percent slopes	7, 452	3. 8
Crater Lake fine sandy loam, 0 to 20 percent slopes	1, 847	. 9
Crater Lake-Snowlin complex, 10 to 30 percent slopes	530	. 3
Deatman very rocky loam, 60 to 80 percent slopes	4, 789	2. 4
Deatman rocky loam, 40 to 60 percent slopes	5, 372	2. 7
Deatman rocky loam, dissected, 40 to 80 percent slopes	2, 476	1. 3
Deatman gravelly loam, 20 to 40 percent slopes	759	. 4
Dumont gravelly loam, 20 to 40 percent slopes	6, 592	3. 3
Dumont gravelly loam, 0 to 20 percent slopes	1, 640	. 8
Dumont gravelly loam, 40 to 60 percent slopes	1, 265	. 6
Fives loam, 20 to 40 percent slopes	9, 077	4. 6
Fives loam, 0 to 20 percent slopes	2, 092	1. 1
Fives loam, 40 to 60 percent slopes	2, 374	1. 2
Fives clay, dark variant, 5 to 30 percent slopes	672	. 3
Freezener gravelly loam, 20 to 40 percent slopes	9, 455	4. 8
Freezener gravelly loam, 0 to 20 percent slopes	2, 548	1. 3
Freezener gravelly loam, 40 to 60 percent slopes	1, 914	1. 0
Freezener clay loam, heavy variant, 20 to 40 percent slopes	948	. 5
Gustin loam, 0 to 30 percent slopes	2, 181	1. 1
Hummington gravelly loam, 40 to 60 percent slopes	747	. 4
Hummington gravelly loam, 20 to 40 percent slopes	612	. 3
Hummington rocky loam, 60 to 80 percent slopes	1, 503	. 8
Hummington rocky loam, dissected, 60 to 80 percent slopes	816	. 4
Landslide, Acker materials	1, 469	. 7
Landslide, Boze materials	718	. 4
Landslide, Dumont materials	659	. 3
Landslide, Fives materials	1, 546	. 8
Landslide, Freezener materials	1, 135	. 6
Landslide, Gustin materials	3, 735	1. 9
Landslide, Zing materials	486	. 2
Prong gravelly loam, 60 to 80 percent slopes	6, 878	3. 5
Prong gravelly loam, dissected, 60 to 80 percent slopes	8, 614	4. 4
Prong gravelly loam, 40 to 60 percent slopes	3, 618	1. 8
Prong gravelly loam, 20 to 40 percent slopes	923	. 5
Prong rocky loam, 80 to 100 percent slopes	443	. 2
Snowlin gravelly loam, 20 to 40 percent slopes	2, 608	1. 4
Snowlin gravelly loam, 0 to 20 percent slopes	1, 597	. 8
Snowlin gravelly loam, 40 to 60 percent slopes	543	. 3
Straight gravelly loam, 40 to 60 percent slopes	2, 878	1. 5
Straight gravelly loam, 60 to 80 percent slopes	3, 550	1. 8
Straight gravelly loam, dissected, 60 to 80 percent slopes	3, 199	1. 6
Straight gravelly loam, 20 to 40 percent slopes	1, 549	. 8
Tuff rock land	3, 584	1. 8
Vena gravelly loam, 40 to 60 percent slopes	3, 637	1. 8
Vena very rocky loam, 80 to 100 percent slopes	718	. 3
Vena very rocky loam, 60 to 80 percent slopes	9, 917	5. 1
Vena very rocky loam, dissected, 60 to 80 percent slopes	15, 737	8. 0
Vena very rocky loam, 20 to 60 percent slopes	3, 895	2. 0
Whitehorse loam, 0 to 20 percent slopes	655	. 3
Whitehorse loam, 20 to 40 percent slopes	637	. 3
Zing loam, 0 to 20 percent slopes	1, 954	1. 0
Lakes	125	. 1
Total	197, 254	100. 0

R—50 inches, light-gray (10YR 7/2) rhyolitic tuff, white (10YR 8/1) when dry; massive; many feet thick.

Depth to bedrock ranges from 40 to more than 60 inches. The solum ranges from 24 to 45 inches in thickness. In places the A and B horizons have a hue of 7.5YR. The A horizon has values of 3 or 4 when moist and chromas of 2 or 3. The B horizon has values of 4 or 5 when moist and chromas of 3 or 4. In places the parent rock is light green, yellowish brown, or light shades of pink.

Included with this soil in mapping are small areas of a somewhat poorly drained soil that has a clay subsoil and that has milder slopes than many areas of this soil. Also included are small areas of a gravelly and very rocky soil that is steeper than many areas of this soil. Other inclusions are soils above 4,000 feet having a cover of true fir and western white pine.

In this Acker soil, roots can penetrate to the bedrock. This soil has moderately slow permeability. Runoff is medium, and the hazard of erosion is moderate. Available water capacity is 6 to 10 inches.

This soil is used for timber, water supply, and wildlife. Capability subclass VIe; soil management group 3.

Acker gravelly loam, 0 to 20 percent slopes (AcC).—This soil is similar to Acker gravelly loam, 20 to 40 percent slopes, but it is less steep and depth to bedrock is about 50 to 75 inches.

Runoff is slow, and the hazard of erosion is slight. Included with this soil in mapping are small marshy areas and small areas of a somewhat poorly drained soil that has a clay subsoil.

This soil is used for timber, water supply, and wildlife. Capability subclass VIe; soil management group 3.

Acker gravelly loam, 40 to 60 percent slopes (AcE).—This soil is similar to Acker gravelly loam, 20 to 40 percent slopes, but it has very steep slopes. Depth to bedrock ranges from 40 to 60 inches. This soil is more gravelly than less sloping Acker soils.

Included with this soil in mapping are small areas of a gravelly and very rocky soil.

Most of the properties and behavior characteristics of this Acker soil are similar to those of Acker gravelly loam, 20 to 40 percent slopes. Runoff is rapid, and the hazard of erosion is severe.

This soil is used for timber, water supply, and wildlife. Capability subclass VIIe; soil management group 5.

Alluvial land

Alluvial land (Al) has gentle slopes and is in long narrow areas adjacent to streams. Most areas are on terraces although a few are on flood plains and alluvial fans.

This land type has a wide range in characteristics, but it is dominantly loamy in texture over gravel or cobblestones.

This land type is in timber and is suitable for all conifers of the Area. It is not suited to campground development because of flash floods. The engineering properties for road construction are variable but generally good. Foot traffic does not compact the soil material.

Included with this land type in mapping are small areas of clayey, poorly drained and very poorly drained soils. In the included areas of poorly drained and very poorly drained soils, structural engineering properties are very poor or poor. The vegetation includes Oregon ash, sedges, reeds, grasses, and water-tolerant plants. Capability subclass VIw; soil management group 11.

Andesite rock land

Andesite rock land (An) is dominantly outcrops of bare andesite rock. In about 70 percent of the acreage slopes are more than 70 percent. In some of the less steep areas are scattered pockets of shallow soils. This land type has about 70 percent rock cover, and rock commonly crops out high above the surrounding terrain. Small patches of grass, a few shrubs, and widely scattered, stunted trees are the only vegetation.

Runoff is very rapid, and the water capacity is low. This land type is an excellent source of rock for surface and base material for roads. It also adds to the scenic beauty of the Area. Capability subclass VIIIs; soil management group 11.

Boze series

The Boze series consists of well-drained gravelly loam soils that overlie bedrock at a depth of more than 40 inches. These soils formed in colluvium weathered from dacite tuff, andesite, and diorite igneous rocks. The topography is mountainous. These soils have slopes ranging from 0 to 40 percent on side slopes, landslides, ridges and toe slopes. Elevations range from 3,000 to 6,000 feet. Annual precipitation is 50 to 70 inches, average annual air temperature is 40° to 45° F., and the frost-free season is 80 to 100 days.

The overstory vegetation is ponderosa pine, Douglas-fir, and sugar pine at elevations of 3,000 to 4,000 feet. Scattered true fir and western white pine grow at elevations above 4,000 feet. The understory is mainly rhododendron, chinquapin, tall red huckleberry, trailing blackberry, and rose.

In a representative profile the surface layer is covered with forest litter and is very dark grayish-brown to dark yellowish-brown gravelly loam. Gravelly loam extends to a depth of 60 inches or more.

Boze gravelly loam, 20 to 40 percent slopes (BoD).—This soil has steep, uneven slopes.

Representative profile in NW¼NW¼ sec. 31, T. 28 S., R. 3 E.:

O1 & O2—1½ inches to 0, loose organic litter of twigs, needles, and cones and partly decomposed twigs, needles, and cones.

A1—0 to 5 inches, very dark grayish-brown (10YR 3/2) gravelly loam, dark grayish brown (10YR 4/2) when dry; weak and moderate, fine and medium, granular structure; soft when dry, very friable when moist, nonsticky and nonplastic when wet; many very fine to medium roots; many fine concretions; 25 percent coarse fragments; medium acid (pH 5.6); clear, smooth boundary. (4 to 8 inches thick)

A3—5 to 13 inches, dark-brown (10YR 3/3) gravelly loam, brown (10YR 5/3) when dry; weak, fine, subangular blocky structure; soft when dry, friable when moist, nonsticky and nonplastic when wet; many very fine to medium roots; many very fine to medium pores; many fine concretions; 25 percent coarse fragments; medium acid (pH 5.6); gradual, smooth boundary. (6 to 10 inches thick)

B2—13 to 20 inches, dark-brown (10YR 4/3) gravelly loam, pale brown (10YR 6/3) when dry; moderate, fine, subangular blocky structure; soft when dry, friable when moist, nonsticky and nonplastic when wet; few fine roots; many very fine interstitial pores; 20 percent coarse fragments; medium acid (pH 5.6); gradual, smooth boundary. (5 to 10 inches thick)

B3—20 to 27 inches, dark-brown (10YR 4/3) gravelly loam, very pale brown (10YR 7/3) when dry; weak, fine, subangular blocky structure; soft when dry, friable when moist, nonsticky and nonplastic when wet; few fine roots; many very fine pores; 20 percent coarse fragments; strongly acid (pH 5.3); gradual, smooth boundary. (5 to 12 inches thick)

C—27 to 60 inches, dark yellowish-brown (10YR 4/4) gravelly loam, very pale brown (10YR 7/4) when dry; massive; soft when dry, friable when moist, nonsticky and nonplastic when wet; many fine and medium roots; many very fine pores; 20 percent coarse fragments; strongly acid (pH 5.4).

The solum ranges from 24 to 40 inches in thickness. Depth to bedrock ranges from 40 to more than 60 inches. The solum is 15 to 35 percent coarse fragments. The amount increases with depth and in many places is greater than 50 percent below a depth of 40 inches. The content of coarse fragments between depths of 10 and 40 inches is 20 to 35 percent.

Included with this soil in mapping are small areas of a very gravelly soil that has a solum only 18 to 40 inches thick. A few small areas have slopes of 40 to 60 percent.

In this Boze soil, roots can penetrate to the bedrock. This soil has moderate permeability. Runoff is medium, and the hazard of erosion is moderate. Available water capacity is 5 to 9 inches.

This soil is used for timber, water supply, and wildlife. Capability subclass VIe; soil management group 2.

Boze gravelly loam, 0 to 20 percent slopes (BoC).—This soil is similar to Boze gravelly loam, 20 to 40 percent slopes, but it is less steep. Depth to bedrock ranges from 60 to 80 inches.

Included with this soil in mapping are small areas of a somewhat poorly drained soil that has a clay loam subsoil. Also included are a few small marshes.

Runoff is slow, and the hazard of erosion is slight.

This soil is used for timber, water supply, and wildlife. Capability subclass VIe; soil management group 2.

Coyata series

The Coyota series consists of well-drained, mainly gravelly loam soils that have a gravelly and very cobbly clay loam subsoil. These soils overlie basalt at a depth of 20 to 40 inches. They formed on uplands in colluvium weathered from basic igneous bedrock. The topography is mountainous. These soils have slopes of 20 to 80 percent on ridges and dissected, smooth and uneven slopes. Elevations range from 1,500 to 4,000 feet. Annual precipita-

tion is 40 to 60 inches, average annual air temperature is 45° to 50° F., and the frost-free season is 100 to 120 days.

The overstory vegetation is Douglas-fir and sugar pine. The understory is mainly chinquapin, madrone, and snowberry.

In a representative profile the surface layer is covered with loose and partly decomposed litter and is dark reddish-brown gravelly loam and gravelly clay loam about 9 inches thick. The subsoil is dark reddish-brown gravelly clay loam, about 16 inches thick, that is very cobbly in the lower part. The substratum is yellowish-red very cobbly clay loam, 15 inches thick. Basalt is at a depth of about 40 inches.

Coyata gravelly loam, 40 to 60 percent slopes (CgE).—This soil has smooth and uneven slopes.

Representative profile in SW¼SW¼ sec. 25, T. 29 S., R. 1 W.:

O1—1½ inches to 1 inch, leaves, twigs, moss, needles, and tree limbs.

O2—1 inch to 0, partly decomposed moss, leaves, needles, and twigs.

A1—0 to 5 inches, dark reddish-brown (5YR 3/3) gravelly loam, reddish brown (5YR 4/3) when dry; moderate, fine and medium, granular structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; many very fine to medium roots; many reddish-brown and black concretions; common white mycelia; 15 percent pebbles; slightly acid (pH 6.1); clear, smooth boundary. (2 to 8 inches thick)

A3—5 to 9 inches, dark reddish-brown (5YR 3/3) gravelly clay loam, reddish brown (5YR 4/3) when dry; moderate, fine and medium, granular structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; many very fine and medium roots; many fine interstitial pores; common reddish-brown and black concretions; many white mycelia; 20 percent pebbles; slightly acid (pH 6.2); clear, smooth boundary. (2 to 6 inches thick)

B1—9 to 13 inches, dark reddish-brown (5YR 3/3) gravelly clay loam, reddish brown (5YR 5/3) when dry; weak, fine and medium, subangular blocky structure; slightly hard when dry, friable when moist, sticky and slightly plastic when wet; common very fine to medium roots; many very fine pores; few reddish-brown and black concretions; many white mycelia; 20 percent pebbles; slightly acid (pH 6.1); clear, wavy boundary. (0 to 5 inches thick)

B2—13 to 20 inches, dark reddish-brown (5YR 3/4) gravelly clay loam, reddish brown (5YR 5/4) when dry; weak, medium and coarse, subangular blocky structure; slightly hard when dry, friable when moist, sticky and slightly plastic when wet; few very fine to medium roots; many very fine to medium pores; few thin clay films in some pores; 20 percent pebbles and 5 percent cobblestones; slightly acid (pH 6.2); clear, wavy boundary. (5 to 10 inches thick)

B3—20 to 25 inches, dark reddish-brown (5YR 3/4) very cobbly clay loam, reddish brown (5YR 5/4) when dry; weak, coarse, subangular blocky structure; slightly hard when dry, friable when moist, sticky and slightly plastic when wet; few very fine to medium roots; common very fine to medium pores; few thin clay films in pores; medium acid (pH 5.9); 30 percent cobblestones and 20 percent pebbles; gradual, wavy boundary. (0 to 5 inches thick)

C—25 to 40 inches, yellowish-red (5YR 4/6) very cobbly clay loam, light brown (7.5YR 6/4) when dry; massive; hard when dry, firm when moist, slightly sticky and slightly plastic when wet; common very fine to medium pores; 40 percent cobblestones and 35 percent pebbles; medium acid (pH 6.0); abrupt, wavy boundary. (0 to 15 inches thick)

R—40 inches, basalt bedrock.

Depth to bedrock ranges from 20 to 40 inches. The A horizon has hue of 5YR and 7.5YR, moist value of 2 or 3, and chroma of 2 or 3. It is mostly cobbly or gravelly but is free of coarse fragments in places. The B3 and C horizons, where present, range in color from dark reddish brown to yellowish red and are loam or clay loam. The B2 horizon is 15 to 30 percent cobblestones and 10 to 20 percent pebbles, and the B3 and C horizons are 30 to 40 percent cobblestones and 20 to 35 percent pebbles.

Included with this soil in mapping are a few small areas of a soil that has a few coarse fragments above the bedrock and soils deeper than 40 inches to bedrock. Rock crops out in most areas.

In this Coyata soil roots can penetrate to the bedrock. This soil has moderate permeability. Runoff is rapid, and the hazard of erosion is severe. Available water capacity is 3 to 6 inches.

This soil is used for timber, water supply, and wildlife. Capability subclass VIIe; soil management group 5.

Coyata gravelly loam, 20 to 40 percent slopes (CgD).—This soil is similar to Coyata gravelly loam, 40 to 60 percent slopes, but is less steep and the subsoil is more clayey. Depth to bedrock ranges from 24 to 40 inches.

Included with this soil in mapping are many small areas of soils that have a few coarse fragments in the subsoil and are more than 40 inches deep over bedrock.

Runoff is medium, and the hazard of erosion is moderate.

This soil is used for timber, water supply, and wildlife. Capability subclass VIe; soil management group 3.

Coyata rocky loam, 60 to 80 percent slopes (CoF).—This soil is similar to Coyata gravelly loam, 40 to 60 percent slopes, but it has very steep slopes and contains more coarse fragments. Rock crops out in 2 to 10 percent of the acreage. Depth to bedrock ranges from 20 to 40 inches.

Runoff from this soil is very rapid, and the hazard of erosion is very severe. Other soil qualities, hazards, and limitations are similar to those of Coyata gravelly loam, 40 to 60 percent slopes.

This soil is used for timber, water supply, and wildlife. Capability subclass VIIe; management group 7.

Coyata rocky loam, dissected, 60 to 80 percent slopes (CpF).—This soil is similar to Coyata gravelly loam, 40 to 60 percent slopes, but it is steeper, contains more coarse fragments, and has slopes incised by shallow drainageways that are nearly parallel and about at right angles to the main valley. Each drainageway is separated by a spur ridge that slopes downward toward the valley. Rock crops out in 2 to 10 percent of the acreage. This soil is thinner and stonier on the spur ridges than in the drainageways. Runoff is very rapid, and the hazard of erosion is very severe. Other soil qualities, hazards, and limitations are similar to those of Coyata gravelly loam, 40 to 60 percent slopes. Depth to bedrock ranges from 20 to 40 inches.

Included with this soil in mapping are small areas of soils that have a few coarse fragments in the subsoil and are more than 40 inches deep over bedrock. Rock crops out along the spur ridges.

This soil is used for timber, water supply, and wildlife. Capability subclass VIIe; soil management group 7.

Crater Lake series

The Crater Lake series consists of well-drained fine sandy loam soils overlying bedrock at depths of more than 40 inches. These soils formed in alluvium derived from ash. They are gently sloping to moderately sloping

on terraces and steep on terrace escarpments. Elevations range from 1,500 to 4,000 feet. Annual precipitation ranges from 40 to 60 inches, average annual air temperature is 45° to 50° F., and the frost-free season is 100 to 120 days.

The overstory vegetation is Douglas-fir, sugar pine, and ponderosa pine. The understory plants are numerous; the main brush plants are ceanothus, trailing blackberry, and vine maple.

In a representative profile the surface layer is covered with loose and partly decomposed litter and is very dark brown to variegated yellowish-brown and light grayish-brown fine sandy loam. Fine sandy loam extends to a depth of 60 inches and more.

Crater Lake fine sandy loam, 0 to 20 percent slopes (CrC).—This soil is on terraces along streams but above the present flood plain.

Representative profile in NE¼NW¼ sec. 7, T. 30 S., R. 1 E.:

O1—1½ inches to 1 inch, loose undecomposed twigs, needles, and leaves.

O2—1 inch to 0, decomposing twigs, needles, and leaves.

A1—0 to 2 inches, very dark brown (10YR 2/2) fine sandy loam, grayish brown and brown (10YR 5/2 and 5/3) when dry; weak, very fine, granular structure; soft when dry, very friable when moist, nonsticky and nonplastic when wet; many very fine to medium roots; slightly acid (pH 6.1); abrupt, wavy boundary. (1 to 4 inches thick)

AC—2 to 15 inches, strong-brown (7.5YR 4/6) fine sandy loam, light yellowish brown (10YR 6/4) when dry; massive; soft when dry, very friable when moist, nonsticky and nonplastic when wet; common very fine to medium roots; slightly acid (pH 6.4); gradual, smooth boundary. (2 to 20 inches thick)

C1—15 to 21 inches, yellowish-brown (10YR 5/6) fine sandy loam, very pale brown (10YR 7/3) when dry; massive; soft when dry, very friable when moist, nonsticky and nonplastic when wet; few very fine to medium roots; slightly acid (pH 6.1); gradual, smooth boundary. (5 to 10 inches thick)

C2—21 to 72 inches, variegated yellowish-brown (10YR 5/4) and light grayish-brown (10YR 6/2) fine sandy loam, very pale brown (10YR 8/4) when dry; massive; soft when dry, very friable when moist, nonsticky and nonplastic when wet; few very fine to medium roots; medium acid (pH 5.9); gradual, smooth boundary. (16 to 60 inches thick)

Depth to bedrock is 40 to more than 60 inches. The AC horizon has moist and dry hues of 10YR or 7.5YR. The deposits of ash range in thickness from 3 feet to more than 20 feet. The particles are mostly of sand and silt size although pumice, pebbles, and cobblestones are also present. The ash deposits overlie a variety of rocks and other kinds of alluvium. In places the ash deposits contain charred logs oriented in the direction of the stream. The profile to a depth of 40 inches or more ranges from fine sandy loam and very fine sandy loam to light silt loam.

Included with this soil in mapping are small areas of terrace escarpments that have slopes of 40 to 60 percent.

In this Crater Lake soil, roots can penetrate deeply. This soil has moderately rapid permeability. Runoff is slow, but the hazard of erosion is severe. Available water capacity to a depth of 5 feet is 12 to 18 inches.

This soil is used for timber, water supply, and wildlife. Capability subclass VIe; soil management group 2.

Crater Lake-Snowlin complex, 10 to 30 percent slopes (CsD).—This complex consists of two soils in about equal proportions. The Crater Lake soil has a profile similar to the one described as representative for the Crater Lake series. The Snowlin soil has a profile similar to the one described under the heading "Snowlin series." The relief is uneven. The Crater Lake soil is on benchlike areas, and the Snowlin soil is in areas between the benchlike areas. Each of these soils occupies areas one-fourth acre to 3 acres in size. Included in mapping are a few small marshes and small lakes.

Soil behavior and management requirements are similar to those of Crater Lake fine sandy loam, 0 to 20 percent slopes, and Snowlin gravelly loam, 20 to 40 percent slopes, except that the Snowlin soil is 1 to 3 degrees warmer than the range in temperature defined for the Snowlin series. This does not alter its use and behavior. Capability subclass VIe; soil management group 2.

Deatman series

The Deatman series consists of well-drained, mainly gravelly sandy clay loam soils that overlie bedrock at a depth of 20 to 40 inches. These soils formed in colluvium weathered from greenish tuff, breccia, and agglomerate. The topography is mountainous. These soils have slopes of 20 to 80 percent on ridges and smooth, uneven and dissected hillsides. Elevations range from 1,500 to 4,000 feet. Annual precipitation is 40 to 60 inches, average annual air temperature is 45° to 50° F., and the frost-free season is 100 to 120 days.

The overstory vegetation is mainly Douglas-fir and sugar pine. The understory is mainly rhododendron, salal, and swordfern.

In a representative profile the surface layer is covered with loose and partly decomposed litter and is very dark grayish-brown gravelly loam about 5 inches thick. The underlying layer is dark-brown to very dark grayish-brown gravelly sandy clay loam, about 20 inches thick. Greenish breccia bedrock is at a depth of about 25 inches.

Deatman very rocky loam, 60 to 80 percent slopes (DtF).—This soil has very steep, smooth and uneven slopes. Rocks crop out in 10 to 25 percent of the acreage.

Representative profile in SE¼NE¼ sec. 23, T. 29 S., R. 1 E.:

O1—1 to ½ inch, loose litter of undecomposed needles, twigs, and leaves.

O2—½ inch to 0, partly decomposed needles, twigs, and leaves.

A1—0 to 5 inches, very dark grayish-brown (10YR 3/2) gravelly loam, brown (10YR 5/3) when dry; weak, fine, granular structure; soft when dry, friable when moist, nonsticky and nonplastic when wet; many very fine and fine roots; many very fine pores; slightly acid (pH 6.0); clear, wavy boundary. (3 to 7 inches thick)

AC—5 to 13 inches, dark-brown (10YR 3/3) gravelly sandy clay loam, brown (10YR 5/3) when dry; weak, fine and medium, granular structure and weak, very fine and fine, subangular blocky structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; few fine and medium roots; many fine pores; medium acid (pH 5.7); gradual, wavy boundary. (5 to 18 inches thick)

C1—13 to 25 inches, very dark grayish-brown (10YR 3/2) gravelly sandy clay loam, grayish brown (2.5Y 5/2) when dry; massive; slightly hard when dry, firm when moist, sticky and slightly plastic when wet; few roots; many very fine to medium pores; few thin clay films in some pores; medium acid (pH 6.2); abrupt, wavy boundary. (10 to 20 inches thick)

IIC2—25 inches, semiconsolidated greenish breccia bedrock.

Depth to bedrock ranges from 20 to 40 inches. The A and AC horizons have hues of 10YR or 7.5YR. The A horizon has values of 2 or 3 moist and 4 or 5 dry, and chromas of 2 or 3 moist and dry. The C horizon has hues of 10YR and 2.5Y and is cobbly or gravelly loam or sandy clay loam. The degree of fracturing in the underlying semiconsolidated bedrock (the IIC2 horizon) is variable, ranging from highly fractured bedrock to solid bedrock.

Included with this soil in mapping are a few small areas where the depth to bedrock is 15 to 20 inches. Rock crops out in places.

In this Deatman soil roots can penetrate to the bedrock. This soil has moderate permeability. Runoff is very rapid, and the hazard of erosion is very severe. Available water capacity is 3 to 6 inches.

This soil is used for timber, water supply, and wildlife. Capability subclass VIIs; soil management group 10.

Deatman gravelly loam, 20 to 40 percent slopes (DeD).—This soil is similar to Deatman very rocky loam, 60 to 80 percent slopes, but rock does not crop out on this soil and slopes are steep and convex. Included in mapping are small areas of soils that have a heavy clay loam or clay subsoil and areas where rock crops out on steep slopes.

Runoff is medium, and the hazard of erosion is moderate.

This soil is used for timber, water supply, and wildlife. Capability subclass VIIe; soil management group 10.

Deatman rocky loam, 40 to 60 percent slopes (DrE).—This soil is similar to Deatman very rocky loam, 60 to 80 percent slopes, but it is less steep and rock crops out in 2 to 10 percent of the acreage. Depth to bedrock ranges from 24 to 40 inches.

Included with this soil in mapping are small areas of soils that have a heavy clay loam or clay subsoil and areas where rock outcrops are common.

Runoff is rapid, and the hazard of erosion is severe.

This soil is used for timber, water supply, and wildlife. Capability subclass VIIe; soil management group 10.

Deatman rocky loam, dissected, 40 to 80 percent slopes (DsE).—This soil (fig. 6) is similar to Deatman very rocky loam, 60 to 80 percent slopes, but the slopes are incised by shallow drainageways that are nearly parallel and at about right angles to the main valley. Each drainageway is separated by a spur ridge that slopes downward toward the valley.

Rock crops out in 2 to 10 percent of the acreage. Runoff is very rapid, and the hazard of erosion is very severe. Depth to bedrock ranges from 24 to 40 inches in the drainageways and on the spur ridges, where numerous rocks crop out.

Included with this soil in mapping are soils on the lower slopes that have a heavy clay loam or clay subsoil.

Other soil qualities, hazards, and limitations are similar to those of Deatman very rocky loam, 60 to 80 percent slopes.

This soil is used for timber, water supply, and wildlife. Capability subclass VIIe; soil management group 10.

Dumont series

The Dumont series consists of well-drained gravelly loam soils that have a mainly clay subsoil. These soils formed in colluvium weathered from reddish tuff and breccia (fig. 7). The topography is mountainous. These soils have 0 to 60 percent slopes and are mainly on ridges, side slopes, and toe slopes. Elevations range from 1,500 to 4,000 feet. Annual precipitation is 40 to 60 inches, average annual air temperature is 45° to 50° F., and the frost-free season is 100 to 120 days.

The overstory vegetation is mainly Douglas-fir, sugar pine, and ponderosa pine. The understory is mainly snowberry and Oregon-grape.

In a representative profile the surface layer is covered with loose and partly decomposed litter and is dark reddish-brown and dark-red gravelly loam about 9 inches thick. The upper part of the subsoil is dark-red clay loam about 13 inches thick. The lower part of the subsoil, to a depth of about 62 inches, is dark-red clay. The substratum is yellowish-red heavy clay loam.

Dumont gravelly loam, 20 to 40 percent slopes (DuD).—This soil makes up more than half the acreage of all Dumont soil (fig. 8). In most of the acreage of this soil slopes are uneven.

Representative profile in NE¼NE¼ sec. 10, T. 29 S., R. 1 E.:

O1—2 inches to 1 inch, loose litter of undecomposed twigs, needles, bark, and leaves.

O2—1 inch to 0, partly decomposed twigs, needles, bark, and leaves.

A11—0 to 4 inches, dark reddish-brown (5YR 3/4) gravelly loam, reddish brown (5YR 5/4) when dry; moderate, fine and medium, granular structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; many very fine to medium roots; numerous shotlike fragments; slightly acid (pH 6.4); clear, wavy boundary. (3 to 6 inches thick)

A12—4 to 9 inches, dark-red (2.5YR 3/4) gravelly loam, light reddish brown (5YR 6/3) when dry; moderate, fine and medium, granular structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; many very fine to coarse roots; common very fine and fine pores; numerous shotlike fragments; medium acid (pH 5.8); clear, wavy boundary. (4 to 6 inches thick)

B1—9 to 14 inches, dark-red (2.5YR 3/6) clay loam, light reddish brown (5YR 6/4) when dry; moderate, coarse, granular and strong, fine, subangular blocky structure; hard when dry, firm when moist, slightly sticky and slightly plastic when wet; common very fine to coarse roots; many very fine pores; few, hard, black shot and small fragments of rock; many patches of white mycelia; medium acid (pH 5.6); clear, wavy boundary. (0 to 6 inches thick)

B21t—14 to 22 inches, dark-red (2.5YR 3/6) clay loam, light reddish brown (2.5YR 6/4) when dry; moderate, very fine and fine, subangular blocky structure; hard when dry, firm when moist, sticky and plastic when wet; few very fine to medium roots; few fine and very fine pores; few, fine, black concretions; common thin clay films on faces of peds; few patches of white mycelia; strongly acid (pH 5.4); clear, smooth boundary. (6 to 9 inches thick)

B22t—22 to 35 inches, dark-red (2.5YR 3/6) clay, reddish brown (5YR 5/4) when dry; moderate, medium to coarse, subangular blocky structure; hard when dry, firm when moist, sticky and plastic when wet; few very fine to medium roots; few fine and very fine pores; few fine concretions; few black stains; common thin clay films on faces of peds; strongly acid (pH 5.4); gradual, smooth boundary. (10 to 17 inches thick)

B23t—35 to 45 inches, dark-red (2.5YR 3/6) clay, reddish brown (5YR 5/4) when dry; moderate, medium and coarse, subangular blocky structure; very hard when dry, firm when moist, and very sticky and very plastic when wet; few very fine and fine roots; few very fine pores; few black stains; nearly continuous moderately

***Figure 6.*—Damage to a cut bank along a road in an area of Deatman rocky loam, dissected, 40 to 80 percent slopes. The damage was caused by sliding of the soil material.**

thick clay films on faces of peds and in pores; strongly acid (pH 5.3); clear, smooth boundary. (7 to 11 inches thick)

B24t—45 to 52 inches, dark-red (2.5YR 3/6) clay, reddish brown (5YR 5/4) when dry; moderate, medium to coarse, subangular blocky structure; very hard when dry, very firm when moist, very sticky and very plastic when wet; few very fine to medium roots; few fine and very fine pores; nearly continuous moderately thick clay films on faces of peds and in pores; strongly acid (pH 5.3); gradual, smooth boundary. (5 to 8 inches thick)

B25t—52 to 62 inches, dark-red (2.5YR 3/6) clay, reddish brown (2.5YR 5/4) when dry; strong, medium to coarse, subangular blocky structure; very hard when dry, very firm when moist, very sticky and very plastic when wet; few very fine to medium roots; few fine and very fine pores; few, soft, black concretions; nearly continuous thick clay films on faces of peds and in pores; very strongly acid (pH 5.0); clear, wavy boundary. (6 to 11 inches thick)

C—62 to 72 inches, yellowish-red (5YR 4/6) heavy clay loam when crushed, reddish brown (5YR 5/4) when dry; massive; hard when dry, friable when moist, sticky and plastic when wet; few fine pores; clay films on some fracture faces and in pores; very strongly acid (pH 4.7); gradual boundary. (15 to 24 inches thick)

Depth to bedrock is 5 feet or more. The solum ranges from 45 to 65 inches in thickness. The A horizon has hues of 2.5YR or 5YR, values of 2 or 3 when moist, and chromas of 2 to 4. It is gravelly loam, gravelly silt loam, gravelly light clay loam, or gravelly light silty clay loam. The B horizon has hues of 2.5YR or 5YR, values of 5 or 6 when dry, and chromas of 4 to 6 moist and dry. It is silty clay, clay, or clay loam.

In this Dumont soil, roots of sugar pine and ponderosa pine can penetrate deeply, but roots of Douglas-fir are restricted and form a mat at a depth of 14 inches. Permeability is moderately slow. Runoff is medium, and the hazard of erosion is moderate. Available water capacity is 8 to 10 inches.

***Figure 7.*—A Dumont gravelly loam showing horizontal bedding of the bedrock of weathered breccia.**

This soil is used for timber, water supply, and wildlife. Capability subclass VIe; soil management group 2.

Dumont gravelly loam, 0 to 20 percent slopes (DuC).—This soil is similar to Dumont gravelly loam, 20 to 40 percent slopes, but it is less steep. Depth to bedrock is 6 feet or more. Runoff is slow, and the hazard of erosion is slight.

Included with this soil in mapping are small areas of a soil that has mottles and yellowish hues in the subsoil. Also included are small marshy areas.

This soil is used for timber, water supply, and wildlife. Capability subclass VIe; soil management group 2.

Dumont gravelly loam, 40 to 60 percent slopes (DuE).—This soil has a profile similar to that of Dumont gravelly loam, 20 to 40 percent slopes, but it is steeper. Depth to bedrock is 5 feet or more. Runoff is rapid, and the hazard of erosion is severe.

Included with this soil in mapping are small areas of a medium-textured or moderately fine textured soil less than 40 inches deep to bedrock, and small areas where rock crops out.

This soil is used for timber, water supply, and wildlife. Capability subclass VIIe; soil management group 5.

Fives series

The Fives series consists of well-drained loamy soils that have a clay loam subsoil. These soils formed in colluvium weathered from greenish tuff and breccia. The topography is mountainous. Slopes range from 0 to 60 percent on bridges, slumps, toe slopes, and side slopes. Elevations are 1,500 to 4,000 feet. Annual precipitation is 40 to 60 inches, average annual air temperature is 45° to 50° F., and the frost-free season is 100 to 120 days.

The overstory vegetation is mainly sugar pine, ponde-

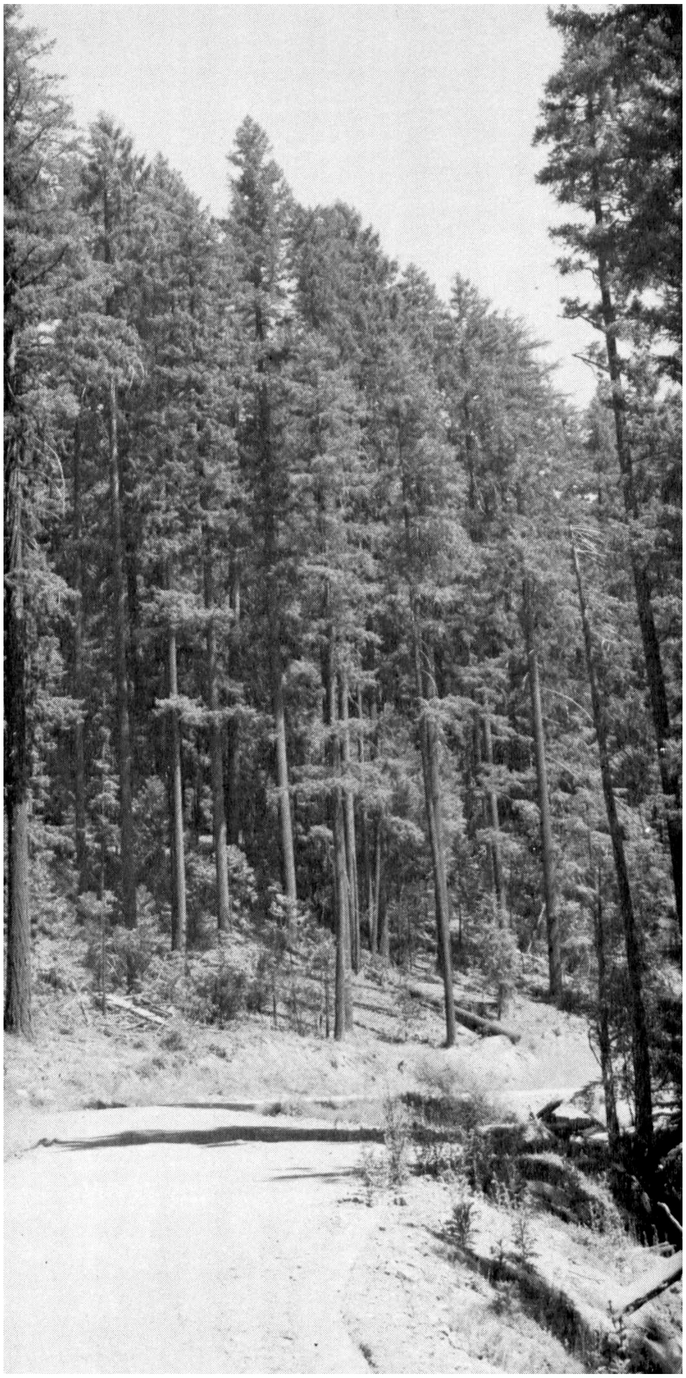

Figure 8.—**Road through an area of Dumont gravelly loam, 20 to 40 percent slopes. This soil provides a fairly stable location for roads.**

rosa pine, and Douglas-fir. The understory is mainly chinquapin, rhododendron, salal, and Oregon-grape.

In a representative profile the surface layer is covered with organic material and is very dark gray and dark grayish-brown loam about 9 inches thick. The subsoil is olive-brown clay loam about 45 inches thick. The substratum is variegated with colors of olive and brown. It is sandy clay loam to a depth of 60 inches and more.

Fives loam, 20 to 40 percent slopes (FsD).—This soil makes up more than half the acreage of all Fives soils. In most of the acreage slopes are uneven.

Representative profile in NW¼SW¼ sec. 2, T. 29 S., R. 2 E.:

O1—2 to 1¼ inches, organic litter of loose leaves, twigs, and needles.

O2—1¼ inches to 0, decomposed leaves, twigs, and needles, very dark brown (10YR 2/2) when moist; abrupt, smooth boundary.

A1—0 to 4 inches, very dark gray (10YR 3/1) loam, light gray (10YR 6/1) when dry; moderate, medium, granular structure; soft when dry, friable when moist, slightly sticky and slightly plastic when wet; many very fine to medium roots; common very fine and fine pores; numerous reddish-brown and black concretions (shot); patches of white mycelia; medium acid (pH 5.7); clear, smooth boundary. (3 to 7 inches thick)

A3—4 to 9 inches, dark grayish-brown (10YR 4/2) heavy loam, light brownish gray (10YR 6/2) when dry; light-gray thin coating on faces of peds; weak, fine, subangular blocky structure and moderate, fine and medium, granular structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; many very fine to coarse roots; common very fine and fine pores; strongly acid (pH 5.3); clear, smooth boundary. (4 to 6 inches thick)

B21t—9 to 17 inches, olive-brown (2.5Y 4/4) clay loam, pale olive (5Y 6/3) when dry; moderate, fine and medium, subangular blocky structure; hard when dry, firm when moist, sticky and very plastic when wet; few very fine to medium roots; common very fine pores; few thin clay films on faces of peds; strongly acid (pH 5.2); clear, wavy boundary. (5 to 10 inches thick)

B22t—17 to 26 inches, olive-brown (2.5Y 4/4) (greenish cast) heavy clay loam, pale olive (5Y 6/3) when dry; moderate, medium to coarse, subangular blocky structure; hard when dry, firm when moist, very sticky and very plastic when wet; few very fine to medium roots; common very fine and fine pores; continuous, moderately thick, reddish-brown and dark-brown clay films on faces of peds; very strongly acid (pH 4.9); gradual, wavy boundary. (6 to 10 inches thick)

B23t—26 to 38 inches, olive-brown (2.5Y 4/4) (greenish cast) clay loam, pale olive (5Y 6/3) when dry; moderate, medium and coarse, subangular blocky structure; hard when dry, firm when moist, very sticky and very plastic when wet; few very fine to medium roots; common fine and very fine pores; continuous, moderately thick, reddish-brown and brown clay films on peds; very strongly acid (pH 5.0); gradual, wavy boundary. (10 to 15 inches thick)

B3t—38 to 54 inches, olive (5Y 5/4) (very greenish hue) light clay loam, pale olive (5Y 6/3) when dry; moderate, medium and coarse, subangular blocky structure; hard when dry, firm when moist, very sticky and very plastic when wet; few very fine to coarse roots; common very fine and fine pores; common, moderately thick, reddish-brown clay films on faces of peds; very strongly acid (pH 5.0); gradual wavy boundary. (5 to 18 inches thick)

C1—54 to 66 inches, variegated colors of brown, olive, dark yellowish-brown sandy clay loam; massive; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; few very fine to coarse roots; common very fine, fine, and medium pores; discontinuous, moderately thick, reddish-brown clay films along fracture planes; very strongly acid (pH 4.9); gradual, wavy boundary. (10 to 30 inches thick)

C2—66 to 72 inches, variegated colors of bluish-green, green, brown, and reddish-brown sandy clay loam; massive; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; few very fine to medium roots; few very fine to medium pores; reddish-brown clay films on faces of weathered rock; very strongly acid (pH 5.0); abrupt, wavy boundary. (10 to 30 inches thick)

The solum ranges from 45 to 60 inches in thickness. Depth to bedrock is more than 60 inches. The A horizon has hues 10YR or 7.5YR, moist values of 3 or 4 in the upper 4 inches and 4 in the lower part, or the A3 horizon, and chromas of 1 or 2. The B horizon has hues of 5Y, 2.5Y, and 10YR, values of 4 or 5 moist and 6 or 7 dry, and chromas of 3 or 4 moist and dry.

Included with this soil in mapping are small areas of a soil that has a mottled clay subsoil. Also included are a few small marshy areas.

In this Fives soil, roots of sugar pine and ponderosa pine can penetrate deeply, but roots of Douglas-fir tend to mat in the upper part of the subsoil. This soil has moderately slow permeability. Runoff is medium, and the hazard of erosion is moderate. Available moisture capacity is 9 to 12 inches.

This soil is used for timber, water supply, and wildlife. Capability subclass VIe; soil management group 2.

Fives loam, 0 to 20 percent slopes (FsC).—This soil is similar to Fives loam, 20 to 40 percent slopes, but it is less steep. Runoff is slow, and the hazard of erosion is slight.

Included with this soil in mapping are small areas of a soil that has a mottled clay subsoil. Also included are a few small marshy areas.

This soil is used for timber, water supply, and wildlife. Capability subclass VIe; soil management group 2.

Fives loam, 40 to 60 percent slopes (FsE).—This soil is similar to Fives loam, 20 to 40 percent slopes, but it is steeper. Runoff is rapid, and the hazard of erosion is severe.

Included with this soil in mapping are small areas of a soil 20 to 40 inches deep to bedrock that has a gravelly loam surface layer and subsoil.

This soil is used for timber, water supply, and wildlife. Capability subclass VIIe; soil management group 5.

Fives series, dark variant

These soils differ enough from the typical Fives soils to be described as a variant, but the acreage in this survey area is not extensive enough to justify establishing a separate series. These are moderately well drained clays that formed in colluvium and residuum weathered from greenish breccia and agglomerate. These soils have smooth and uneven slopes of 5 to 30 percent. Elevations are 1,500 to 3,000 feet. Annual precipitation is 40 to 60 inches, average annual air temperature is 45° to 50° F., and the frost-free season is 100 to 120 days.

The vegetation is mostly grass with scattered ponderosa pine, Oregon white oak, and poison-oak.

The surface layer is mainly black clay about 23 inches thick. The subsoil is olive-brown clay about 27 inches thick, the lower 10 inches of which is faintly mottled. The substratum is mottled olive heavy clay loam to a depth of 60 inches and more.

Fives clay, dark variant, 5 to 30 percent slopes (FtD).—Representative profile in SE¼NE¼ sec. 33, T. 29 S., R. 1 E.:

A11—0 to 5 inches, black (10YR 2/1) clay, dark grayish brown (10YR 4/2) when dry; moderate, fine and medium, subangular blocky and granular structure; hard when dry, friable when moist, sticky and plastic when wet; many very fine roots; medium acid (pH 6.0); gradual, smooth boundary. (4 to 8 inches thick)

A12—5 to 11 inches, black (10YR 2/1) clay, dark gray (10YR 4/1) when dry; moderate, fine and medium, subangular blocky structure; hard when dry, friable when moist, sticky and plastic when wet; many very fine roots; slightly acid (pH 6.2); gradual, smooth boundary. (4 to 8 inches thick)

A3—11 to 23 inches, variegated black (10YR 2/1) and very dark brown (10YR 2/2) clay, very dark gray (10YR 3/1) and very dark grayish brown (10YR 3/2) when dry; moderate, medium and coarse, subangular blocky structure; very hard when dry, firm when moist, very sticky and very plastic when wet; few very fine roots; few very fine and fine pores; slightly acid (pH 6.4); abrupt, wavy boundary. (8 to 14 inches thick)

B2—23 to 40 inches, olive-brown (2.5Y 4/4) clay, light olive brown (2.5Y 5/4) when dry; weak, coarse, prismatic and moderate, coarse, subangular blocky structure; very hard when dry, firm when moist, very sticky and very plastic when wet; few very fine roots; common very fine pores; continuous, moderately thick, very dark brown organic coatings on peds and in pores; neutral (pH 6.6); gradual, smooth boundary. (15 to 36 inches thick)

B3—40 to 50 inches, olive-brown (2.5Y 4/4) clay, light olive brown (2.5Y 5/4) when dry; common, medium, faint, dark yellowish-brown (10YR 4/4 moist) mottles; weak, coarse, subangular blocky structure; very hard when dry, firm when moist, very sticky and very plastic when wet; few, thin, very dark brown organic coatings on peds and in pores; neutral (pH 6.6); gradual, smooth boundary. (5 to 15 inches thick)

C—50 to 60 inches, olive (5Y 4/3) heavy clay loam, olive gray (5Y 5/2) when dry; many, medium and coarse, faint and prominent, light olive-brown (2.5Y 5/4), light olive-brown (2.5Y 3/3 moist), and yellowish-red (5YR 4/6 moist) mottles; massive; hard when dry, friable when moist, sticky and plastic when wet; many very fine and fine pores; neutral (pH 6.7).

The solum ranges from 36 to 60 inches in thickness. Depth to bedrock is more than 60 inches. The A horizon ranges from black to very dark brown. The B horizon has hues of 2.5Y or 10YR and values of 3 or 4 when moist.

Included with this soil in mapping are small areas of a soil that is mottled in the upper part of the subsoil and is very dark grayish brown in the surface layer. Small marshy areas, seeps, and springs are also included.

In this Fives soil the clayey subsoil restricts the depth to which the roots of most trees can penetrate. Permeability is slow. Runoff is slow to medium, and there is a slight to moderate hazard of erosion. Available water capacity is 9 to 11 inches.

This soil is used for timber, water supply, and wildlife. Capability subclass VIe; soil management group 11.

Freezener series

The Freezener series consists of well-drained gravelly loam soils that have a mainly clay subsoil overlying bedrock at depths of more than 40 inches. These soils formed in colluvium weathered from basic igneous rock. The parent rocks are intrusive basalt, basalt-flow, dolerite, and some andesite. The topography is mountainous. Slopes range from 0 to 60 percent. These soils are on side slopes, ridges, and toe slopes at elevations of 1,500 to 4,000 feet. Annual precipitation is 40 to 60 inches, average annual air temperature is 45° to 50° F., and the frost-free season is 100 to 120 days.

The overstory vegetation is Douglas-fir, sugar pine, and ponderosa pine. The understory is mainly ceanothus, snowberry, whipple vine, rose, and oceanspray.

In a representative profile the surface layer is covered with litter and is dark reddish-brown gravelly loam about 9 inches thick. The upper part of the subsoil is reddish-brown clay loam about 7 inches thick. The lower part of the subsoil is reddish-brown silty clay and clay about

40 inches thick. The substratum, to a depth of 60 inches and more, is reddish-brown cobbly clay loam.

Freezener gravelly loam, 20 to 40 percent slopes (FvD).—In about two-thirds of the acreage of this soil slopes are uneven.

Representative profile in SE¼SE¼ sec. 21, T. 28 S., R. 2 E.:

O1—1 inch to 0, very dark gray (10YR 3/1) partly decomposed needles, leaves, and twigs.

A1—0 to 9 inches, dark reddish-brown (10YR 3/3) gravelly loam, brown (7.5YR 5/2) when dry; moderate, fine and medium, granular structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; many very fine to medium roots; many very fine to fine pores; common white mycelia on faces of peds; many, fine, dark reddish-brown and black concretions; strongly acid (pH 5.4); clear, smooth boundary. (4 to 9 inches thick)

B1—9 to 16 inches, reddish-brown (5YR 4/3) clay loam, brown (7.5YR 5/4) when dry; moderate, fine and medium, subangular blocky structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; many very fine to coarse roots; many very fine and fine pores; few, fine, dark reddish-brown and black concretions; strongly acid (pH 5.2); clear, smooth boundary. (6 to 18 inches thick)

B21t—16 to 24 inches, reddish-brown (5YR 4/4) silty clay, brown (7.5YR 5/4) when dry; moderate, medium and coarse, subangular blocky structure; very hard when dry, firm when moist, sticky and plastic when wet; few fine and very fine roots; common very fine and fine pores; nearly continuous moderately thick clay films on faces of peds and in pores; strongly acid (pH 5.2); gradual, smooth boundary. (5 to 10 inches thick)

B22t—24 to 32 inches, reddish-brown (5YR 4/4) clay, strong brown (7.5YR 5/6) when dry; strong, medium and coarse, subangular blocky structure; very hard, firm, sticky and plastic when wet; few very fine roots; few very fine and fine pores; nearly continuous moderately thick clay films on faces of peds and in pores; strongly acid (pH 5.1); gradual, smooth boundary. (5 to 10 inches thick)

B23t—32 to 45 inches, reddish-brown (5YR 4/4) clay, brown (7.5YR 5/4) when dry; common, faint, yellowish-red (5YR 5/6) mottles; strong, medium and coarse, subangular blocky structure; very hard when dry, firm when moist, sticky and plastic when wet; few very fine roots; few very fine and fine pores; common, moderately thick, yellowish-red (5YR 4/6) clay films on faces of peds and in pores; common, medium, black stains; very strongly acid (pH 5.0); gradual smooth boundary. (5 to 15 inches thick)

B3t—45 to 56 inches, reddish-brown (5YR 4/4) heavy clay loam, brown (7.5YR 5/4) when dry; common, fine, distinct, red (2.5YR 4/6) mottles; weak, medium, subangular blocky structure; hard when dry, firm when moist, slightly sticky and plastic when wet; few very fine roots, few very fine pores; common thin clay films on faces of peds; few, fine, black stains; strongly acid (pH 5.1); clear, smooth boundary. (7 to 15 inches thick)

C—56 to 72 inches, reddish-brown (5YR 4/4) cobbly clay loam, brown (7.5YR 5/4) when dry; massive; hard when dry, firm when moist, slightly sticky and slightly plastic; few very fine and fine pores; 35 percent cobblestones and stones by volume; strongly acid (pH 5.1).

The solum ranges from 40 to 72 inches in thickness; it commonly is less than 60 inches thick. Depth to bedrock is 40 inches to more than 60 inches. The A horizon has values of 2 or 3 when moist and chromas of 3 or 4. The B horizon has hues of 5YR and 2.5YR and moist values of 3 or 4. It is heavy clay loam, heavy silty clay loam, silty clay, or clay and contains 35 to 50 percent clay. The C horizon commonly is reddish-brown or dark reddish-brown clay loam and loam grading into basalt bedrock.

Included with this soil in mapping are small areas of a soil that has mottles and yellowish hues in the B2 horizon.

In this Freezener soil, roots can penetrate deeply. Permeability is moderately slow. Runoff is medium, and the hazard of erosion is moderate. The available water capacity is 6 to 12 inches.

This soil is used for timber (fig. 9), water supply, and wildlife. Capability subclass VIe; soil management group 1.

Freezener gravelly loam, 0 to 20 percent slopes (FvC).—This soil is similar to Freezener gravelly loam, 20 to 40 percent slopes, but it is less steep. Runoff is slow, and the hazard of erosion is slight.

Included with this soil in mapping are small areas of a soil that has mottles and yellowish hues in the subsoil. Also included are some small marshy areas.

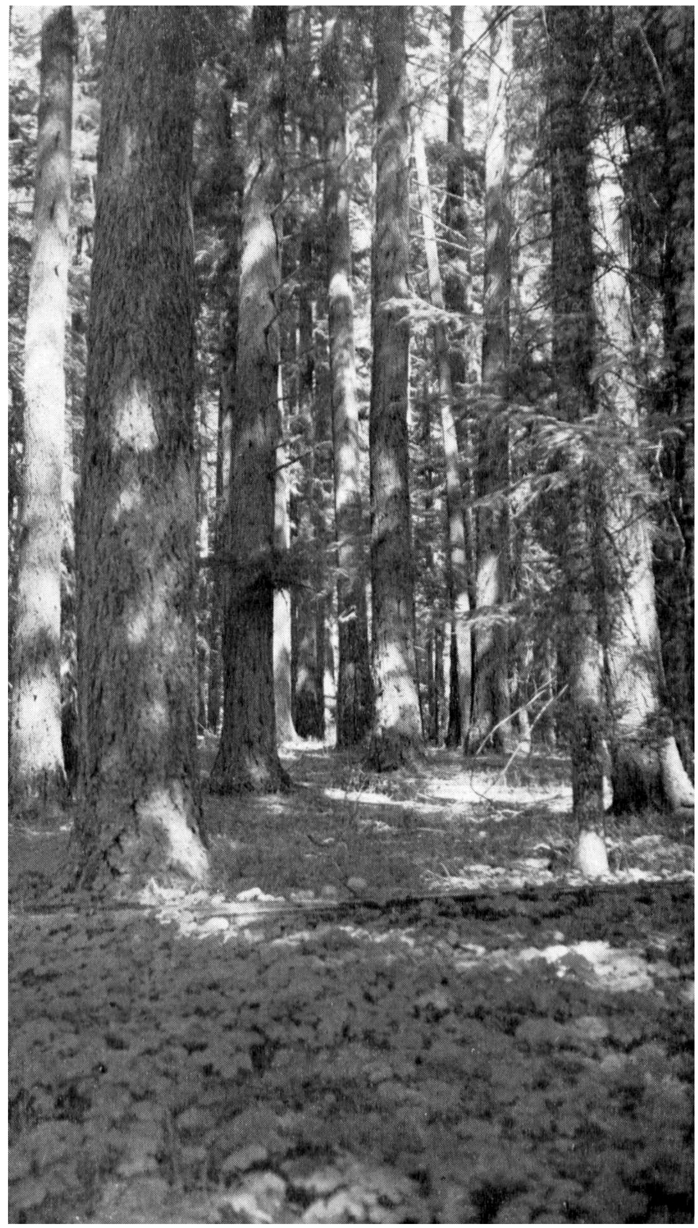

Figure 9.—**Stand of mature trees on a Freezener soil that is well suited to trees. No brushy plants have invaded the understory.**

This soil is used for timber, water supply, and wildlife. Capability subclass VIe; soil management group 1.

Freezener gravelly loam, 40 to 60 percent slopes (FvE).—This soil is similar to Freezener gravelly loam, 20 to 40 percent slopes, but it is steep. Runoff is rapid, and the hazard of erosion is severe.

Included with this soil in mapping are small areas of a soil that is 20 to 40 inches deep over bedrock and is very cobbly below a depth of 20 inches. A few rock outcrops are also included.

This soil is used for timber, water supply, and wildlife. Capability subclass VIIe; soil management group 6.

Freezener series, heavy variant

This soil differs enough from the typical Freezener soils to be described as a variant, but it is not sufficiently extensive in this survey area to justify establishing a separate series. It is a well-drained clay loam that has a mainly clay subsoil. It formed in colluvium and residuum weathered from basic igneous rock. The topography is mountainous. This soil has slopes ranging from 20 to 40 percent. It is commonly on south-facing slopes at elevations of 1,500 to 3,000 feet. Annual precipitation is 40 to 60 inches, average annual air temperature is 45° to 50° F., and the frost-free season is 100 to 120 days.

The vegetation is mostly grass and ponderosa pine and scattered Douglas-fir and sugar pine.

In a representative profile the surface layer is 12 inches thick and is dark-brown clay loam. The subsoil, to a depth of 47 inches, is dark reddish-brown clay. Below this, to a depth of 60 inches and more, is dark-brown clay loam.

Freezener clay loam, heavy variant, 20 to 40 percent slopes (FzD).—Representative profile in SW¼NE¼ sec. 7, T. 30 S., R. 1 E.:

O1—1 inch to 0, twigs, needles, and leaves.

A11—0 to 5 inches, dark-brown (7.5YR 3/2) clay loam, brown (7.5YR 4/2) when dry; weak, fine and medium, granular structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; many very fine and fine roots; many very fine irregular pores; medium acid (pH 5.8); gradual, wavy boundary. (4 to 9 inches thick)

A12—5 to 12 inches, dark-brown (7.5YR 3/3) clay loam, brown (7.5YR 5/2) when dry; weak, moderate and medium, granular structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; common very fine and fine roots; medium acid (pH 5.9); clear, wavy boundary. (5 to 10 inches thick)

B1t—12 to 21 inches, dark-brown (7.5YR 3/3) clay, dark reddish gray (5YR 4/2) when dry; weak, fine, subangular blocky structure; hard when dry, firm when moist, sticky and plastic when wet; common roots; many very fine and fine pores; few thin clay films; medium acid (pH 5.9); clear, smooth boundary. (0 to 13 inches thick)

B21t—21 to 32 inches, dark reddish-brown (5YR 3/4) clay, reddish brown (5YR 4/3) when dry; moderate, fine and medium, subangular blocky structure; hard when dry, firm when moist, very sticky and very plastic when wet; few roots; common very fine pores; nearly continuous moderately thick clay films; common, fine, soft fragments of weathered rock; medium acid (pH 5.8); clear, smooth boundary. (8 to 14 inches thick)

B22t—32 to 47 inches, dark reddish-brown (5YR 3/4) clay, reddish brown (5YR 5/3) when dry; strong, coarse, prismatic structure with slickensides; very hard when dry, very firm when moist, very sticky and very plastic when wet; few very fine roots; few very fine pores; continuous thick clay films; common, fine, soft fragments of weathered and hard rock; few, fine, red and black concretions; medium acid (pH 5.6); gradual, wavy boundary. (10 to 25 inches thick)

B3t—47 to 63 inches, dark-brown (7.5YR 4/4) clay loam, brown (7.5YR 5/4) when dry; weak, fine and medium, subangular blocky structure; hard when dry, firm when moist, sticky and plastic when wet; few very fine pores; common moderately thick clay films on peds and in pores; strongly acid (pH 5.2); gradual, smooth boundary. (10 to 25 inches thick)

C—63 to 72 inches, dark-brown (7.5YR 4/4) clay loam, brown (7.5YR 5/4) when dry; massive; hard when dry, firm when moist, sticky and plastic when wet; few very fine pores; few moderately thick clay films on fractures and cavities; strongly acid (pH 5.2).

Depth to bedrock is 60 to more than 100 inches. The B horizon has hues of 7.5YR and 5YR, values of 3 or 4 when moist and 4 or 5 when dry, and chromas of 3 or 4.

Included with this soil in mapping are small areas of a soil that has a mottled subsoil and slopes of less than 20 percent. Also included are small areas of soils that have a clay loam subsoil and slopes of more than 20 percent. Rock crops out in a few places, and there are a few small marshy areas.

In this Freezener heavy variant, the clay subsoil limits root penetration. Permeability is slow. Runoff is medium, and the hazard of erosion is moderate. The available water capacity is 8 to 10 inches.

This soil is used for grazing, timber, water supply and wildlife. Capability VIe; soil management group 8.

Gustin series

The Gustin series consists of moderately well drained loam soils that have a mainly clay subsoil. Bedrock is at a depth of more than 40 inches. These soils formed in colluvium weathered from intermediate breccia, agglomerate, and rhyolitic tuff. The topography is mountainous. Slopes are 0 to 30 percent, and elevations are 1,500 to 4,000 feet. Annual precipitation is 40 to 60 inches, average annual air temperature is 45° to 50° F., and the frost-free season is 100 to 120 days.

The overstory vegetation is mainly ponderosa pine, sugar pine, Douglas-fir, and hemlock. The understory is vine maple, salal, beargrass, dull Oregon-grape, swordfern, and twinflower (fig. 10).

In a representative profile the surface layer is covered with organic material and is very dark grayish-brown loam about 5 inches thick. The subsurface layer is dark grayish-brown loam about 5 inches thick. The upper part of the subsoil is dark-brown clay loam about 7 inches thick. The lower part of the subsoil is mottled dark grayish-brown, grayish-brown, and gray silty clay and clay about 36 inches thick. The substratum, to a depth of 66 inches and more, is mottled gray heavy loam.

Gustin loam, 0 to 30 percent slopes (GuD).—This soil has smooth and uneven slopes.

Representative profile in SE¼SW¼ sec. 23, T. 29 S., R. 1 E.:

O1&O2—2 inches to 0, twigs, needles, leaves, over partly decomposed twigs, needles, leaves.

A1—0 to 5 inches, very dark grayish-brown (10YR 3/2) loam, light brownish gray (10YR 6/2) when dry; moderate, fine and medium, granular structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; many very fine to medium roots; many very fine pores; common light-gray coatings on faces of peds; many, hard, black

***Figure 10.*—Stand of mature trees on Gustin loam, 0 to 30 percent slopes. Numerous brushy plants make up the understory.**

and reddish-brown concretions; many patches of white mycelia; medium acid (pH 5.9); clear, wavy boundary. (3 to 6 inches thick)

A2—5 to 10 inches, dark grayish-brown (10YR 4/2) loam, light gray (10YR 7/2) when dry; moderate, fine and medium, granular structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; many very fine, fine, and medium roots; medium acid (pH 5.6); clear, wavy boundary. (3 to 6 inches thick)

B1t—10 to 17 inches, dark-brown (10YR 4/3) light clay loam, pale brown (10YR 6/3) when dry; weak, fine and medium, subangular blocky structure parting to weak, fine to coarse, granular structure; hard when dry, friable when moist, slightly sticky and slightly plastic when wet; few very fine to coarse roots; few very fine pores; few, fine, firm, reddish-brown and black concretions; few thin clay films on faces of peds; very strongly acid (pH 5.0); clear, smooth boundary. (6 to 11 inches thick)

B21t—17 to 23 inches, 50 percent dark grayish-brown (10 YR 4/2) and 50 percent dark yellowish-brown (10YR 4/4) silty clay, light brownish gray (10YR 6/2), light gray (10YR 7/2), and yellowish brown (10YR 5/6) when dry; moderate, fine and medium, subangular blocky structure; hard when dry, firm when moist, plastic and sticky when wet; common very fine and fine roots; common very fine pores; few, thin and moderately thick, brown clay films on peds; very strongly acid (pH 4.8); clear, smooth boundary. (5 to 8 inches thick)

B22t—23 to 37 inches, grayish-brown (10YR 5/2) clay, light olive gray (5Y 6/2) when dry; many, large, distinct, yellowish-brown (10YR 5/4) mottles; moderate, medium and coarse, subangular blocky structure (appears massive when wet); very hard when dry, firm when moist, very sticky and very plastic when wet; few very fine to medium roots; few very fine pores; nearly continuous, thick, brown and gray clay films on faces of peds; few moderately thick clay films along old root channels; extremely acid (pH 4.3); gradual, irregular boundary. (10 to 20 inches thick)

B3t—37 to 53 inches, gray (10YR 6/1) light clay, light gray, white, and very pale brown (10YR 7/1, 8/1 to 8/3) when dry; common, medium, distinct, strong-brown (7YR 5/6) mottles; moderate, medium and coarse, subangular blocky structure (appears massive when wet); hard when dry, firm when moist, very sticky and very plastic when wet; nearly continuous thick clay films on faces of peds; extremely acid (pH 4.2); clear, smooth boundary. (0 to 25 inches thick)

C—53 to 66 inches, mottled gray (10YR 6/1) and strong-brown (7.5YR 5/6) heavy loam, light gray (10YR 7/1) and reddish yellow (7.5YR 6/6 and 6/8) when dry; massive; hard when dry, firm when moist; very sticky and very plastic when wet; very few very fine roots; few thick clay films along weathered rock faces; very strongly acid (pH 4.9).

R—66 inches, rhyolitic tuff.

Depth to bedrock ranges from 40 inches to more than 60 inches. The solum ranges from 36 to 55 inches in thickness. The shades of green or olive in the soil matrix vary directly with the color of the parent materials. The A1 horizon has values of 2 or 3 when moist, and chromas are 2 or less. The A2 horizon has dry values of 6 or 7. The A horizon is gravelly in places. The B horizon has hues of 10YR or 2.5Y, values of 4 to 5 moist, and chromas of 2 to 4. The degree of mottling is faint to distinct in the B2 horizon. The C horizon generally has variegated colors of red, green, yellow, and brown.

Included with this soil in mapping are small areas of a well-drained soil that lacks mottles. Very small marshy areas also are included.

In this Gustin soil, sugar pine and ponderosa pine roots can penetrate deeply, but Douglas-fir roots tend to form a mat in the upper part of the clayey subsoil. Permeability is slow. Runoff is slow to medium, and there is a slight to moderate hazard of erosion. The available water capacity is 6 to 10 inches.

This soil is used for timber, water supply, and wildlife. Capability subclass VIe; soil management group 8.

Hummington series

The Hummington series consists of well-drained soils that have a very gravelly loam subsoil and overlie basalt at depths of 20 to 40 inches. These soils formed in colluvium derived from basalt, other basic igneous rocks, and pumice. The topography is mountainous. Slopes range from 20 to 80 percent and elevations from 3,000 to 6,000 feet. Annual precipitation is 50 to 70 inches, the

average annual air temperature is 40° to 45° F., and the frost-free season is 40 to 80 days.

The overstory vegetation is mainly Douglas-fir, true fir, and western hemlock. The understory is mainly vine maple and rhododendron.

In a representative profile the surface layer is covered with organic material and is very dark brown and dark grayish-brown gravelly loam about 10 inches thick. The subsoil is dark-brown gravelly and very cobbly loam about 21 inches thick. Basalt bedrock is at a depth of about 31 inches.

Hummington gravelly loam, 40 to 60 percent slopes (HbE).—This soil has uneven and smooth slopes.

Representative profile in NE¼SE¼ sec. 30, T. 27 S., R. 3 E.:

O1&O2—1½ inches to 0, loose litter of undecomposed needles, twigs, and leaves and partly decomposed needles, twigs, and leaves.

A11—0 to 4 inches, very dark brown (10YR 2/2) gravelly loam, dark grayish brown (10YR 4/2) when dry; moderate, fine and very fine, granular structure; soft when dry, friable when moist, nonsticky and nonplastic when wet; 10 percent pebbles and 5 percent cobblestones of basalt; many very fine to medium roots; many very fine irregular pores; strongly acid (pH 5.4); gradual, wavy boundary. (2 to 6 inches thick)

A12—4 to 10 inches, very dark grayish-brown (10YR 3/2) gravelly loam, dark grayish brown (10YR 4/2) when dry; moderate, fine and medium, granular structure; soft when dry, friable when moist, nonsticky and nonplastic when wet; 15 percent pebbles and 5 percent cobblestones of basalt; many very fine to medium roots; many very fine irregular pores; strongly acid (pH 5.4); gradual, wavy boundary. (4 to 8 inches thick)

B21—10 to 19 inches, dark-brown (10YR 3/3) gravelly loam, brown (10YR 5/3) when dry; massive; soft when dry, friable when moist, nonsticky and nonplastic when wet; 25 percent pebbles and 10 percent cobblestones of basalt; many very fine to medium roots; many very fine irregular pores; strongly acid (pH 5.5); gradual, wavy boundary. (6 to 10 inches thick)

IIB22—19 to 31 inches, dark-brown (10YR 3/3) very cobbly loam, brown (10YR 5/3) when dry; 40 percent cobblestones, and 35 percent pebbles; massive; soft when dry, friable when moist, slightly sticky and slightly plastic when wet; few fine and medium roots; many very fine irregular pores; strongly acid (pH 5.2); abrupt, irregular boundary. (8 to 15 inches thick)

IIR—31 inches, basalt bedrock.

Depth to bedrock ranges from 20 to 40 inches. The A11 horizon has moist values of 2 or 3. It has weak or moderate, fine and very fine, granular structure and is gravelly or very gravelly loam or sandy loam. The A12 horizon has chromas of 2 or 3 moist and dry. It has weak or moderate, fine or medium, granular or very fine subangular blocky structure and is gravelly loam or gravelly sandy loam. The B2 horizon has values of 3 or 4 moist and 5 or 6 dry. It has massive or weak subangular blocky structure and is 20 to 40 percent cobblestones and 15 to 35 percent gravel.

Included with this soil in mapping are small areas of a soil deeper than 40 inches to bedrock, and small areas of another soil that has a thick, very dark brown surface layer. Rock crops out in a few places.

In this Hummington soil, roots can penetrate to the bedrock. Permeability is moderately rapid. Runoff is rapid, and the hazard of erosion is severe. The available water capacity is 2 to 5.5 inches.

This soil is used for timber, water supply, and wildlife. Capability subclass VIIe; soil management group 5.

Hummington gravelly loam, 20 to 40 percent slopes (HbD).—This soil is similar to Hummington gravelly loam, 40 to 60 percent slopes, but it is less steep. It is at higher elevation than other Hummington soils. Runoff is medium, and the hazard of erosion is moderate.

Included with this soil in mapping are small areas of a soil deeper than 40 inches to bedrock, and small areas of a soil that has a thick, very dark brown surface layer. Rock crops out in a few places.

This soil is used for timber, water supply, and wildlife. Capability subclass VIe; soil management group 3.

Hummington rocky loam, 60 to 80 percent slopes (HrF).—This soil is similar to Hummington gravelly loam, 40 to 60 percent slopes, but it is steeper. Rock crops out in 2 to 10 percent of the acreage. Runoff is very rapid, and the hazard of erosion is severe.

This soil is used for timber, water supply, and wildlife. Capability subclass VIIe; soil management group 7.

Hummington rocky loam, dissected, 60 to 80 percent slopes (HuF).—This soil is similar to Hummington gravelly loam, 40 to 60 percent slopes, but it is steeper and the slopes are incised by shallow drainageways that are nearly parallel and at about right angles to the main valley. Each drainageway is separated by a spur ridge that slopes downward toward the valley. Rock crops out in 2 to 10 percent of the acreage. Runoff is very rapid, and the hazard of erosion is very severe.

Included with this soil in mapping are small areas of a soil deeper than 40 inches to bedrock, and small areas of a soil that has a thick, very dark brown surface layer.

The soil is used for timber, water supply, and wildlife. Capability subclass VIIe; soil management group 7.

Landslides

Landslides are areas of unstable soil material and loose rock that are subject to sliding, usually when wet or saturated. The speed and the distance of movement in such areas, as well as the amount of soil and rock material, vary greatly.

Landslide, Acker materials (La) is in drainageways and has a hummocky microrelief. It forms a sharp angle with soils on adjacent higher slopes. Slopes are 0 to 20 percent. Depth to bedrock ranges from 50 to more than 60 inches.

Included in mapping are small areas of a somewhat poorly drained soil that has a clay subsoil and small areas of a very gravelly soil. Also included are small marshes and some large boulders.

This land type has a profile similar to that of Acker gravelly loam, 20 to 40 percent slopes, but the soil horizons are somewhat mixed because of past movement. Most of the characteristics of this land type are similar to those of Acker gravelly loam, 20 to 40 percent slopes; however, this soil material is unstable. The sweep and crook defect in trees is evidence of this instability.

This land type is used for timber, water supply, and wildlife. Capability subclass VIe; soil management group 4.

Landslide, Boze materials (Lb) has slopes of 10 to 40 percent. Depth to bedrock is more than 60 inches.

This land type has a profile similar to that of Boze gravelly loam, 20 to 40 percent slopes, but the soil horizons are somewhat mixed because of past movement. Most of

the characteristics of this land type are similar to those of Boze gravelly loam, 20 to 40 percent slopes.

Included with this land type in mapping are small areas of a somewhat poorly drained soil that has a clay loam subsoil, and areas of a very stony soil that is 18 to 45 inches deep. In a few places there are large boulders on the surface. The acreage of inclusions is greater than that in mapping units of the Boze series.

This land type is used for timber, water supply, and wildlife. Capability subclass VIe; soil management group 4.

Landslide, Dumont materials (Ld) has slopes of 10 to 40 percent. Depth to bedrock is more than 60 inches.

This land type has a profile similar to that of Dumont gravelly loam, 20 to 40 percent slopes, but the horizons are somewhat mixed because of past movements. Most of the characteristics of this land type are similar to those of Dumont gravelly loam, 20 to 40 percent slopes.

Included with this land type in mapping are small areas of a soil that has moderate slopes, mottles, and yellowish hues in the subsoil. Also included are small areas along streams of a soil that has a loam or clay subsoil and is less than 40 inches deep to bedrock. In places there are a few large boulders. The acreage of inclusions is greater than that in mapping units of the Dumont series.

This land type is used for timber, water supply, and wildlife. Capability subclass VIe; soil management group 4.

Landslide, Fives materials (Le) has slopes of 10 to 40 percent. Depth to bedrock is more than 60 inches.

This land type has a profile similar to Fives loam, 20 to 40 percent slopes, but the horizons are somewhat mixed because of past movement. Most of the characteristics of this land type are similar to those of Fives loam, 20 to 40 percent slopes.

Included with this land type in mapping are small areas of a soil that has a mottled clay subsoil. Also included are areas of a soil that is 20 to 40 inches deep to bedrock and has a gravelly loam surface layer and subsoil. Small marshy areas and a few large boulders are present in most areas. The acreage of inclusions is greater than that in mapping units of the Fives series.

This land type is used for timber, water supply, and wildlife. Capability subclass VIe; soil management group 4.

Landslide, Freezener materials (Lf) has slopes of 10 to 40 percent. Depth to bedrock is more than 60 inches.

This land type has a profile similar to Freezener gravelly loam, 20 to 40 percent slopes, but the horizons are somewhat mixed because of past movement. Most of the characteristics of this land type are similar to those of Freezener gravelly loam, 20 to 40 percent slopes.

Included with this soil in mapping are small areas of a soil that has mottles and yellowish hues in the subsoil, and small areas of a soil that is 20 to 40 inches deep to bedrock and very cobbly below a depth of 20 inches. There are a few large boulders in places. The acreage of inclusions is greater than that in mapping units of the Freezener series.

This land type is used for timber, water supply, and wildlife. Capability subclass VIe; soil management group 4.

Landslide, Gustin materials (Lg) has slopes of 10 to 40 percent. Depth to bedrock is more than 50 inches.

This land type has a soil profile similar to that of Gustin loam, 0 to 30 percent slopes, but the horizons are somewhat mixed because of past movement. Most of the characteristics of this land type are similar to that of Gustin loam, 0 to 30 percent slopes.

Included with this land type in mapping are small areas of a steeper, well-drained soil that has a clay loam subsoil, and small areas near streams of a very gravelly loam soil. Small marshy areas and a few large boulders are also included in this mapping unit. The acreage of inclusions is greater than that in mapping units of the Gustin soils.

This land type is used for timber, water supply, and wildlife. Capability subclass VIIe; soil management group 4.

Landslide, Zing materials (Lz) has slopes of 10 to 40 percent. Depth to bedrock is more than 60 inches.

This land type has a soil profile similar to that of Zing loam, 0 to 20 percent slopes, but the horizons are somewhat mixed because of past movement. Most of the characteristics of this land type are similar to those of Zing loam, 0 to 20 percent slopes.

Included with this land type in mapping are small areas of a soil that is well drained and has a dark reddish-brown surface layer and dark-red subsoil, and areas of another dark reddish-brown soil that is very stony below a depth of about 20 inches. There are a few large boulders in places. The acreage of inclusions is greater than that in the mapping unit Zing loam, 0 to 20 percent slopes.

This land type is used for timber, water supply, and wildlife. Capability subclass VIIe; soil management group 4.

Prong series

The Prong series consists of well-drained gravelly loam soils that have a very gravelly sandy loam subsoil overlying bedrock at a depth of 20 to 40 inches. These soils formed in colluvium weathered from tuff, dacite, or andesite. The topography is mountainous. Slopes range from 20 to 100 percent and elevations from 3,000 to 6,000 feet. Annual precipitation is 50 to 70 inches, the average annual air temperature is 40° to 45° F., and the frost-free season is 80 to 100 days.

The overstory vegetation is mainly sugar pine and Douglas-fir. The understory is chinquapin, rhododendron, vine maple, huckleberry, Oregon-grape, and rose.

In a representative profile the surface layer is covered with organic material and is very dark brown and very dark grayish-brown gravelly loam and gravelly sandy loam about 13 inches thick. The subsoil is dark-brown very gravelly sandy loam about 12 inches thick. Andesite bedrock is at a depth of about 25 inches.

Prong gravelly loam, 60 to 80 percent slopes (PgF).—This soil has uneven and smooth slopes.

Representative profile in NW¼SE¼ sec. 31, T. 28 S., R. 3 E.:

O1&O2—1½ inches to 0, loose litter of undecomposed needles, twigs, leaves, and partly decomposing organic matter.

A11—0 to 6 inches, very dark brown (10YR 2/2) gravelly loam, dark grayish brown (10YR 4/2) when dry; weak, very fine, granular structure; soft when dry,

very friable when moist, nonsticky and nonplastic when wet; many very fine to coarse roots; 25 percent coarse fragments; strongly acid (pH 5.2); gradual, wavy boundary. (3 to 8 inches thick)

A12—6 to 13 inches, very dark grayish-brown (10YR 3/2) gravelly sandy loam, grayish brown (10YR 5/2) when dry; weak, very fine, granular structure; soft when dry, very friable when moist, nonsticky and nonplastic when wet; many very fine to coarse roots; 40 percent coarse fragments; slightly acid (pH 6.1); clear, wavy boundary. (4 to 12 inches thick)

B2—13 to 25 inches, dark-brown (10YR 3/3) very gravelly sandy loam, brown (10YR 5/3) when dry; massive; soft when dry, very friable when moist, nonsticky and nonplastic when wet; 60 percent coarse fragments; common very fine to coarse roots; slightly acid (pH 6.2); abrupt, irregular boundary. (10 to 25 inches thick)

IIR—25 inches, fractured andesite bedrock.

Depth to bedrock ranges from 20 to 40 inches. The moist color of the A11 horizon ranges from very dark brown to very dark grayish brown. The horizon is gravelly or very gravelly loam or sandy loam. The color of the A12 horizon generally is very dark grayish brown or dark brown when moist; dry colors are grayish brown or brown. The structure is weak granular or very fine subangular blocky. The B2 horizon is similar to the A horizon but has moist values of 3 or 4. This horizon is 35 to 75 percent coarse fragments by volume.

Natural slides are common on this soil, and rock crops out in many places.

In this Prong soil, roots can penetrate to the bedrock. Permeability is moderately rapid. Runoff is very rapid, and there is a very severe hazard of erosion. The available water capacity is 1.5 to 2.5 inches.

This soil is used for timber, water supply, and wildlife. Capability subclass VIIe; soil management group 10.

Prong gravelly loam, 20 to 40 percent slopes (PgD).—This soil is similar to Prong gravelly loam, 60 to 80 percent slopes, but it is less steep. Runoff is medium, and there is a moderate hazard of erosion.

Included with this soil in mapping are small areas of a soil that lacks stones and is more than 40 inches deep over bedrock.

This soil is used for timber, water supply, and wildlife. Capability subclass VIIe; soil management group 9.

Prong gravelly loam, 40 to 60 percent slopes (PgE).—This soil is similar to Prong gravelly loam, 60 to 80 percent slopes, but it is less steep. Runoff is rapid, and there is a severe hazard of erosion.

Included with this soil in mapping are small areas of a soil that lacks gravel and is more than 40 inches deep over bedrock. Rock crops out in a few places.

This soil is used for timber, water supply, and wildlife. Capability subclass VIIe; soil management group 9.

Prong gravelly loam, dissected, 60 to 80 percent slopes (PoF).—This soil is similar to Prong gravelly loam, 60 to 80 percent slopes, but slopes are incised by shallow drainageways that are nearly parallel and at about right angles to the main valley. Each drainageway is separated by a spur ridge that slopes downward toward the valley. Runoff is very rapid, and there is a severe hazard of erosion.

Included with this soil in mapping are small areas of a soil that lacks gravel and is more than 40 inches deep over bedrock. Rock crops out in a few places along the spur ridges.

This soil is used for timber, water supply, and wildlife. Capability subclass VIIe; soil management group 10.

Prong rocky loam, 80 to 100 percent slopes (PrF).—This soil is similar to Prong gravelly loam, 60 to 80 percent slopes, but it is steeper. Depth to bedrock ranges from 20 to 30 inches. There are many natural slides, and rock crops out in 2 to 10 percent of the acreage. Runoff is very rapid, and the hazard of erosion is severe.

This soil is used for timber, water supply, and wildlife. Capability subclass VIIe; soil management group 10.

Snowlin series

The Snowlin series consists of well-drained gravelly loams that have a cobbly clay loam subsoil. These soils overlie bedrock at a depth of more than 50 inches. They formed in colluvial material weathered from basalt, other basic igneous rock, and pumice or ash. The topography is mountainous. Slopes range from 0 to 60 percent, and elevations from 3,000 to 6,000 feet. Annual precipitation is 50 to 70 inches, average annual air temperature is 40° to 45° F., and the frost-free season is 40 to 80 days.

The overstory vegetation is mainly Douglas-fir, but true fir and western white pine grow at elevations above 4,000 feet. The understory is vine maple, rhododendron, huckleberry, ceanothus, serviceberry, and beargrass.

In a representative profile the surface layer is covered with organic material and is very dark brown and very dark grayish-brown gravelly loam about 20 inches thick. The upper part of the subsoil is dark yellowish-brown cobbly clay loam about 19 inches thick. The lower part of the subsoil is dark yellowish-brown and dark-brown clay loam about 21 inches thick. The substratum is dark-brown cobbly heavy clay loam, 9 inches or more thick.

Snowlin gravelly loam, 20 to 40 percent slopes (SnD).—In most of the acreage slopes are uneven.

Representative profile in SE¼SE¼ sec. 30, T. 27 S., R. 3 E:

O1&O2—2½ inches to 0, loose litter of undecomposed twigs, needles, cones, and leaves and partly decomposed twigs, needles, cones, and leaves.

A11—0 to 5 inches, very dark brown (10YR 2/2) gravelly loam, dark grayish brown (10YR 4/2) when dry; moderate, fine and very fine, granular structure; soft when dry, friable when moist, nonsticky and nonplastic when wet; many very fine and fine roots; many irregular fine pores; 5 percent pumice and many dark-colored fine concretions; 20 percent pebbles and 5 percent cobblestones and stones; strongly acid (pH 5.4); gradual, wavy boundary. (3 to 9 inches thick)

A12—5 to 12 inches, very dark brown (10YR 2/2) gravelly loam, dark grayish brown (10YR 4/2) when dry; moderate, fine, granular structure; soft when dry, friable when moist, nonsticky and nonplastic when wet; many very fine to medium roots; many fine irregular pores; 5 percent pumice and many, dark, fine concretions; 20 percent pebbles and 5 percent cobblestones and stones; white mycelia present; strongly acid (pH 5.2); clear, wavy boundary. (3 to 9 inches thick)

A3—12 to 20 inches, very dark grayish-brown (10YR 3/2) gravelly loam, dark brown (10YR 4/3) when dry; weak to moderate, fine and medium, granular structure; soft when dry, friable when moist, nonsticky and nonplastic when wet; common very fine to medium roots; many very fine and fine pores; 5 percent pumice; 10 percent pebbles and 5 percent cobblestones and stones; strongly acid (pH 5.3); abrupt, wavy boundary. (5 to 8 inches thick)

IIB1—20 to 34 inches, dark yellowish-brown (10YR 3/4) cobbly clay loam, pale brown (10YR 6/3) when dry; moderate, fine and medium, subangular blocky structure; slightly hard when dry, friable when moist, nonsticky and nonplastic when wet; common very fine to medium roots; common very fine and fine pores; 20

percent cobblestones and 10 percent pebbles; 2 percent pumice; strongly acid (pH 5.2); gradual, wavy boundary. (0 to 18 inches thick)

IIB21—34 to 39 inches, dark yellowish-brown (10YR 3/4) cobbly clay loam, pale brown (10YR 6/3) when dry; moderate, fine and very fine, subangular blocky structure; slightly hard when dry, friable when moist; slightly sticky and slightly plastic when wet; few very fine to medium roots; common very fine pores; 15 percent cobblestones and 5 percent pebbles; few fine pumice fragments; strongly acid (pH 5.1); clear, wavy boundary. (3 to 6 inches thick)

IIB22—39 to 50 inches, dark yellowish-brown (10YR 3/4) clay loam, brown (10YR 5/3) when dry; moderate, very fine and fine, subangular blocky structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; few very fine roots; common fine pumice fragments; very strongly acid (pH 5.0); gradual, wavy boundary. (6 to 14 inches thick)

IIB3—50 to 60 inches, dark-brown (10YR 4/3) clay loam, brown (10YR 5/3) when dry; weak to moderate, fine and medium, subangular blocky structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; few very fine roots; common very fine pores; very strongly acid (pH 5.0); 10 percent coarse fragments; gradual, wavy boundary. (0 to 12 inches thick)

IIC—60 to 69 inches, dark-brown (10YR 4/3) cobbly heavy clay loam, brown (10YR 5/3) when dry; massive; hard when dry, friable when moist, slightly sticky and slightly plastic when wet; common very fine pores; 20 percent cobblestones and stones and 10 percent pebbles; very strongly acid (pH 4.9).

The solum ranges from 30 to 70 inches in thickness. Depth to bedrock is more than 50 inches. Stone lines are common in soils that have slopes of more than 10 percent. The A horizon ranges from 15 to 20 inches in thickness and from gravelly loam to gravelly silt loam in texture.

Included with this soil in mapping are small areas of a soil that has a very dark brown surface layer more than 20 inches thick, and areas of a gravelly loam soil that is 25 to 40 inches deep over bedrock.

In this Snowlin soil, roots can penetrate deeply. Permeability is moderately slow. Runoff is medium, and there is a moderate hazard of erosion. Available water capacity is 7 to 11 inches.

This soil is used for timber, water supply, and wildlife. Capability subclass VIe; soil management group 1.

Snowlin gravelly loam, 0 to 20 percent slopes (SnC).—This soil is similar to Snowlin gravelly loam, 20 to 40 percent slopes, but it is less steep. Runoff is slow to medium, and there is a slight to moderate hazard of erosion.

Included with this soil in mapping are small areas of a soil that has a very dark brown surface layer more than 20 inches thick. Also included are a few very small marshy areas.

This soil is used for timber, water supply, and wildlife. Capability subclass VIe; soil management group 1.

Snowlin gravelly loam, 40 to 60 percent slopes (SnE).—This soil is similar to Snowlin gravelly loam, 20 to 40 percent slopes, but it is steeper. Runoff is rapid, and the hazard of erosion is severe.

Included with this soil in mapping are small areas of a soil that has a very dark brown surface layer more than 20 inches thick, and a gravelly loam soil that is 25 to 40 inches deep over bedrock. Rock crops out in a few places.

This soil is used for timber, water supply, and wildlife. Capability subclass VIIe; soil management group 6.

Straight series

The Straight series consists of well-drained soils that have a very gravelly loam subsoil and overlie bedrock at a depth of 20 to 40 inches. These soils formed in colluvium weathered from reddish breccia. The topography is mountainous. Slopes range from 20 to 80 percent, and elevations from 1,500 to 4,000 feet. Annual precipitation is 40 to 60 inches. Average annual air temperature is 45° to 50° F., and the frost-free season is 100 to 120 days.

The overstory vegetation is mainly Douglas-fir and sugar pine. The main understory plants are chinquapin, salal, and western brackenfern.

In a representative profile the surface layer is covered with organic material and is dark reddish-brown gravelly loam about 5 inches thick. The subsoil is dark reddish-brown to reddish-brown very gravelly loam about 20 inches thick. Weathered reddish breccia bedrock is at a depth of about 25 inches.

Straight gravelly loam, 40 to 60 percent slopes (StE).—This soil has uneven and smooth slopes.

Representative profile in SW¼NE¼ sec. 34, T. 28 S., R. 1 E.:

O1&O2—2 inches to 0, loose litter of undecomposed tree limbs, twigs, needles, leaves, and cones over partly decomposed twigs, needles, and leaves.

A1—0 to 5 inches, dark reddish-brown (5YR 3/3) gravelly loam, light reddish brown (5YR 6/3) when dry; moderate, fine and medium, granular structure and moderate, very fine, subangular blocky structure; soft when dry, friable when moist, nonsticky and nonplastic when wet; many very fine to medium roots; many interstitial pores; few black concretions; 25 percent pebbles and 15 percent cobblestones; medium acid (pH 5.9); clear, smooth boundary. (3 to 7 inches thick)

B21—5 to 12 inches, dark reddish-brown (5YR 3/4) very gravelly loam, light reddish brown (5YR 6/4) when dry; moderate, medium, granular structure; soft when dry, friable when moist, nonsticky and nonplastic when wet; common very fine to coarse roots; many very fine and fine tubular pores; few black concretions; 40 percent pebbles and 20 percent cobblestones; medium acid (pH 5.9); gradual, wavy boundary. (3 to 10 inches thick)

B22—12 to 25 inches, reddish-brown (5YR 4/4) very gravelly loam, light reddish brown (5YR 6/4) when dry; weak and moderate, fine and very fine, subangular blocky structure; soft when dry, friable when moist, nonsticky and nonplastic when wet; common very fine to coarse roots; common very fine and fine pores; 40 percent pebbles and 20 percent cobblestones; medium acid (pH 5.7); clear, wavy boundary. (6 to 15 inches thick)

C—25 inches, weathered reddish breccia bedrock.

Depth to bedrock ranges from 20 to 40 inches. Hues are 5YR and 2.5YR throughout the profile. Texture ranges from loam to clay loam. Within the profile there is little or no change in texture with increasing depth. The A horizon is 10 to 35 percent gravel and 5 to 15 percent cobblestones. The B horizon is 25 to 50 percent gravel and 10 to 25 percent cobblestones.

Included with this soil in mapping are small areas of a clay soil that is deep over breccia bedrock. Bedrock crops out in places.

In this Straight soil, roots can penetrate to the bedrock. This soil has moderate permeability. Runoff is rapid, and the hazard of erosion is severe. Available water capacity is 1.5 to 4 inches.

This soil is used for timber, water supply, and wildlife. Capability subclass VIIe; soil management group 9.

Straight gravelly loam, 20 to 40 percent slopes (StD).—This soil is similar to Straight gravelly loam, 40 to 60 percent slopes, but it is less steep. It has convex slopes and is upslope from other Straight soils. Runoff is medium, and the hazard of erosion is moderate.

Included with this soil in mapping are small areas of a clay soil that is deep over breccia bedrock. Bedrock crops out in many places.

This soil is used for timber, water supply, and wildlife. Capability subclass VIIe; soil management group 9.

Straight gravelly loam, 60 to 80 percent slopes (StF).—This soil is similar to Straight gravelly loam, 40 to 60 percent slopes, but it is steeper. Runoff is very rapid, and the hazard of erosion is very severe.

This soil is used for timber, water supply, and wildlife. Capability subclass VIIe; soil management group 10.

Straight gravelly loam, dissected, 60 to 80 percent slopes (SuF).—This soil is similar to Straight gravelly loam, 40 to 60 percent slopes, but it is steeper and the slopes are incised by shallow drainageways that are nearly parallel and at about right angles to the main valley. Each drainageway is separated by a ridge that slopes downward toward the valley. This soil is thinnest on the ridges and thickest in the draws. Runoff is very rapid, and the hazard of erosion is very severe.

Included with this soil in mapping are small areas of a deep clay soil. Rock crops out along the spur ridges.

This soil is used for timber, water supply, and wildlife. Capability subclass VIIe; soil management group 10.

Tuff rock land

Tuff rock land (Tv) consists of reddish, greenish, and buff-colored tuff and breccia. Small areas of quartz diorite, gabbro, and metamorphosed breccia are included in mapping. About 70 percent of the acreage is bare rock and rock pinnacles. Slopes are more than 70 percent in more than three-fourths of the acreage. Some of the less sloping areas have small pockets of very shallow soil that has a shrub or grass cover. Small patches of grass, wild flowers, a few shrubs, and widely scattered stunted trees are the only vegetation.

The various rocks in this land type generally are not suitable for road surfacing or base materials. Water storage is extremely low, and runoff is very rapid. This land type is scenic and provides many excellent observation points. It is best suited to wildlife, water supply, and recreational uses. Capability subclass VIIIs; soil management group 11.

Vena series

The Vena series consists of well-drained very gravelly loam soils that overlie bedrock at a depth of 20 to 40 inches. These soils formed in colluvium weathered from acid igneous rock, dominantly rhyolite. The topography is mountainous. Slopes range from 20 to 100 percent, and elevations from 1,500 to 4,000 feet. Annual precipitation is 40 to 60 inches, average annual air temperature is 45° to 50° F., and the frost-free season is 80 to 120 days.

The overstory vegetation is Douglas-fir and sugar pine. The understory is chinquapin, rhododendron, salal, oceanspray, red huckleberry, serviceberry, and blackberry.

In a representative profile the surface layer is covered with organic material and is very dark grayish-brown gravelly loam about 5 inches thick. The subsoil is dark grayish-brown to grayish-brown very gravelly loam about 16 inches thick. Rhyolitic tuff bedrock is at a depth of about 21 inches.

Vena very rocky loam, 60 to 80 percent slopes (VrF).—In most of the acreage slopes are smooth. Rock crops out in 10 to 25 percent of the acreage.

Representative profile in NE¼NW¼ sec. 30, T. 28 S., R. 2 E.:

O1—1¼ inches to 0, loose litter of twigs, needles, and tree branches and partly decomposed twigs, tree limbs, needles, leaves, and bark.

A1—0 to 5 inches, very dark grayish-brown (10YR 3/2) gravelly loam, gray (10YR 6/1) when dry; weak, fine, granular structure; soft when dry, very friable when moist, nonsticky and nonplastic when wet; many very fine to medium roots; 20 percent pebbles and 5 percent cobblestones; many white mycelia; medium acid (pH 5.6); clear, smooth boundary. (3 to 9 inches thick)

AC—5 to 9 inches, dark grayish-brown (10YR 4/2) very gravelly loam, light gray (10YR 7/1) when dry; weak, fine and medium, granular structure; soft when dry, very friable when moist, nonsticky and nonplastic when wet; many very fine to coarse roots; 25 percent pebbles and 10 percent cobblestones; medium acid (pH 6.0); clear, smooth boundary. (3 to 10 inches thick)

C—9 to 21 inches, grayish-brown (10YR 5/2) very gravelly loam, light gray (10YR 7/1) when dry; massive; soft when dry, very friable when moist, nonsticky and nonplastic when wet; many very fine to medium roots; 40 percent pebbles and 15 percent cobblestones; strongly acid (pH 5.5); abrupt, wavy boundary. (10 to 30 inches thick)

R—21 inches, fractured rhyolitic tuff bedrock that has soil materials along fractures.

Depth to bedrock ranges from 20 to 40 inches. Texture of the A horizon ranges from gravelly loam to stony loam or stony sandy loam. When moist, the A horizon has values of 2 or 3 and chromas of 3 or less. When moist, the AC and C horizons have values of 4 to 5 and chromas of 2 to 3. They are loam to fine sandy loam and are 25 to 40 percent coarse pebbles and 5 to 15 percent cobblestones.

Included with this soil in mapping are natural slides. Rock crops out in many places. True fir and western white pine grow at elevations above 4,000 feet.

In this Vena soil roots can penetrate to the bedrock. Permeability is moderate. Runoff is very rapid, and there is a severe hazard of erosion (fig. 11). Available water capacity is 1.5 to 4 inches.

This soil is used for timber, water supply, and wildlife. Capability subclass VIIs; soil management group 10.

Vena gravelly loam, 40 to 60 percent slopes (VeE).—This soil is similar to Vena very rocky loam, 60 to 80 percent slopes, but it has less steep slopes and rock crops out in less than 2 percent of the acreage. Runoff is rapid, and the hazard of erosion is severe.

Included with this soil in mapping are small areas of a deep soil that has a clay loam subsoil. Rock crops out in a few places.

This soil is used for timber, water supply, and wildlife. Capability subclass VIIe; soil management group 10.

Vena very rocky loam, 20 to 60 percent slopes (VrE).—This soil is similar to Vena very rocky loam, 60 to 80 percent slopes, but it is less steep. This soil is upslope from other Vena soils. Runoff is medium to rapid, and the hazard of erosion is moderate to severe.

Figure 11.—**An area of Vena very rocky loam, 60 to 80 percent slopes. The crook at the base of many of the trees was caused by snow or soil creep.**

Included with this soil in mapping are small areas of a deep soil that has a clay loam subsoil.

This soil is used for timber, water supply, and wildlife. Capability subclass VIIs; soil management group 10.

Vena very rocky loam, dissected, 60 to 80 percent slopes (VvF).—This soil is similar to Vena very rocky loam, 60 to 80 percent slopes, but it contains more coarse fragments and the slopes are incised by shallow drainageways that are nearly parallel and at about right angles to the main valley. Each drainageway is separated by a spur ridge that slopes downward toward the valley. This soil is thinner and stonier on the spur ridges than in the drainageways. Runoff is very rapid, and the hazard of erosion is very severe.

Included with this soil in mapping are small areas of a deep soil that has a clay loam subsoil.

This soil is used for timber, water supply, and wildlife. Capability subclass VIIs; soil management group 10.

Vena very rocky loam, 80 to 100 percent slopes (VrG).—This soil is similar to Vena very rocky loam, 60 to 80 percent slopes, but it is steeper. Depth to bedrock ranges from 20 to 30 inches. Runoff is very rapid, and the hazard of erosion is severe.

Included with this soil in mapping are small areas of soils less than 20 inches deep to bedrock.

This soil is used for timber, water supply, and wildlife. Capability subclass VIIs; soil management group 10.

Whitehorse series

The Whitehorse series consists of well-drained loam soils that have a gravelly clay loam subsoil. These soils overlie bedrock at a depth of 40 inches. They formed in a thin layer of ash and pumice and the underlying colluvium derived from basalt and other basic igneous rock. The topography is mountainous. Slopes range from 0 to 40 percent and elevations from 4,000 to 7,000 feet.

Annual precipitation is 60 to 70 inches, average annual air temperature is 38° to 43° F., and the frost-free season is 40 to 60 days. The vegetation is mainly ferns, herbs, and grasses.

In a representative profile the surface layer is covered with organic material and is very dark brown loam about 29 inches thick. The subsoil is dark yellowish-brown gravelly clay loam about 7 inches thick. The substratum is friable, dark-brown gravelly clay loam about 22 inches thick. Bedrock is at a depth of about 58 inches.

Whitehorse loam, 0 to 20 percent slopes (WhC).—This soil has smooth slopes.

Representative profile in NW¼SE¼ sec. 30, T. 27 S., R. 3 E.:

O1&O2—1 inch to 0, partly decomposed organic matter and fine roots.

A11—0 to 12 inches, very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) when dry; weak, very fine, granular structure; soft when dry, very friable when moist, nonsticky and nonplastic when wet; many very fine roots; many very fine interstitial pores; 5 percent pumice; strongly acid (pH 5.2); gradual, wavy boundary. (8 to 14 inches thick)

A12—12 to 20 inches, very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) when dark; weak, very fine, granular structure; soft when dry, very friable when moist, nonsticky and nonplastic when wet; many very fine roots; many very fine interstitial pores; 5 percent pumice; very strongly acid (pH 5.0); gradual, wavy boundary. (6 to 10 inches thick)

A13—20 to 29 inches, very dark brown (10YR 22) loam, dark grayish brown (10YR 4/2) when dry; weak, very fine, granular structure; soft when dry, very friable when moist, nonsticky and nonplastic when wet; many very fine roots; many very fine interstitial pores; 5 percent pumice; very strongly acid (pH 5.0); abrupt, wavy boundary. (6 to 10 inches thick)

IIB2—29 to 36 inches, dark yellowish-brown (10YR 3/4) gravelly clay loam, brown (10YR 5/3) when dry; moderate, fine, subangular blocky structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; few very fine roots; many very fine and fine tubular pores; 5 percent pumice, 20 percent partly weathered basic igneous pebbles, and 5 percent cobblestones; very strongly acid (pH 4.7); clear, wavy boundary. (4 to 8 inches thick)

IIC—36 to 58 inches, dark-brown (7.5YR 3/2) and dark yellowish-brown (10YR 3/4) gravelly clay loam, brown (7.5YR 5/2) when dry; massive; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; few very fine roots; many very fine tubular pores; 5 percent pumice, 25 percent partly weathered basic igneous pebbles, and 5 percent cobblestones; very strongly acid (pH 4.9); abrupt, wavy boundary. (15 to 40 inches thick)

IIIR—58 inches, fractured basic igneous rock.

As much as 15 percent of the soil is pumice. The A horizon ranges from 24 to 32 inches in thickness. The IIB horizon ranges from loam to clay loam in texture and from dark brown to dark yellowish brown in color. Depth to bedrock ranges from 40 to more than 60 inches.

Included with this soil in mapping are small areas of a similar soil that has a surface layer less than 24 inches thick. Small marshes and springs also are included in this mapping unit.

In this Whitehorse soil, roots can penetrate deeply. Permeability is moderately slow. Runoff is slow to medium, and there is a slight to moderate hazard of erosion. Available water capacity is 6 to 11 inches.

The soil is used for water supply, wildlife, and recreation, and for limited grazing by livestock. Capability subclass VIe; soil management group 11.

Whitehorse loam, 20 to 40 percent slopes (WhD).—This soil is similar to Whitehorse loam, 0 to 20 percent slopes, but it is steeper. Runoff is medium, and there is a moderate hazard of erosion.

Included with this soil in mapping are small areas of a soil that is very stony below a depth of about 20 inches. Rock crops out in a few places.

The soil is used for water supply, wildlife, recreation, and limited grazing by livestock. Capability subclass VIe; soil management group 11.

Zing series

The Zing series consists of moderately well drained loams that have a mainly clay subsoil. These soils formed in colluvium weathered from basic igneous rock. Slopes are 0 to 20 percent. Elevations are 1,500 to 4,000 feet. The annual precipitation is 40 to 60 inches. Average annual air temperature is 45° to 50° F., and the frost-free season is 100 to 120 days.

The overstory vegetation is mainly ponderosa pine, sugar pine, and Douglas-fir. The understory is salal, oceanspray, snowberry, hazel, beargrass, and shiny Oregon-grape.

In a representative profile the surface layer is covered with organic material and is very dark brown loam about 6 inches thick. The upper part of the subsoil is dark-brown clay loam about 10 inches thick. The lower part of the subsoil is mottled light olive-brown clay about 20 inches thick. The substratum is light olive-brown clay loam that extends to a depth of 60 inches or more.

Zing loam, 0 to 20 percent slopes (ZgC).—This soil has uneven and smooth slopes.

Representative profile in SW¼SE¼ sec. 21, T. 28 S., R. 2 E.:

O1—1½ inches to 0, loose undecomposed and partly decomposed twigs, needles, and leaves.

A1—0 to 6 inches, very dark brown (7.5YR 2/2) loam, dark brown (7.5YR 4/2) when dry; moderate, medium, granular structure; soft when dry, friable when moist, slightly sticky and slightly plastic when wet; many very fine and fine roots; many interstitial pores; medium acid (pH 5.8); clear, smooth boundary. (3 to 10 inches thick)

B11—6 to 12 inches, dark-brown (7.5YR 3/3) clay loam, brown (10YR 5/3) when dry; moderate, fine, subangular blocky structure; soft when dry, friable when moist, slightly sticky and slightly plastic when wet; many very fine and fine roots; common very fine and fine tubular pores; medium acid (pH 5.6); clear, wavy boundary. (3 to 7 inches thick)

B12—12 to 16 inches, dark brown (10YR 4/3) clay loam, pale brown (10YR 6/3) when dry; moderate, fine, subangular blocky structure; slightly hard when dry, friable when moist, sticky and plastic when wet; common very fine and fine roots; common very fine tubular pores; common reddish-brown and black stains on peds; strongly acid (pH 5.2); clear, smooth boundary. (4 to 8 inches thick)

B2t—16 to 28 inches, light olive-brown (2.5Y 5/4) clay, pale olive (5YR 6/3) when dry; few, fine, distinct mottles; moderate, coarse, prismatic structure; very hard when dry, firm when moist, very sticky and very plastic when wet; few very fine roots; common fine and very fine tubular pores; few thin clay films on faces of prisms and in some pores; neutral (pH 6.6); gradual, smooth boundary. (10 to 20 inches thick)

B3t—28 to 36 inches, light olive-brown (2.5Y 5/4) clay, pale yellow (5Y 7/3) when dry; many, medium, distinct, strong-brown (7.5YR 5/6) mottles; moderate, medium, subangular block structure; hard when dry, firm when moist, sticky and plastic when wet; common very

fine tubular pores; continuous, moderately thick clay films on faces of peds; neutral (pH 6.7); gradual, smooth boundary. (0 to 15 inches thick)

C—36 to 60 inches, light olive-brown (2.5Y 5/4) clay loam, pale yellow (5Y 7/3) when dry; massive; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; many black stains and concretions; common very fine tubular pores; moderately thick clay films in some pores; neutral (pH 7.0).

Bedrock is at a depth of more than 60 inches. The solum ranges from 30 to 45 inches in thickness. The A horizon ranges from very dark grayish-brown to very dark brown loam to silty clay loam. The B horizon is heavy silty clay loam, heavy clay loam, or clay. Hue in the B horizon is dominantly 5Y or 2.5Y, but is 10YR in places. In places the C horizon is stratified loam and clay loam ranging from olive to brown and grayish brown in color.

Included with this soil in mapping are small areas of a soil that lacks mottles and has a dark reddish-brown surface layer and a dark-red subsoil.

In this Zing soil ponderosa pine roots can penetrate deeply, but Douglas-fir roots spread out on top of the subsoil. This soil has slow permeability. Runoff is slow to medium, and the hazard of erosion is slight to moderate. Available water capacity is 10 to 12 inches.

This soil is used primarily for timber, water supply, and wildlife. Capability subclass VIe; soil management group 8.

Formation, Morphology, and Classification of Soils

This section explains how the soils formed and how they are classified. The discussion of soil genesis includes information about soil morphology and classification. Laboratory data are included for selected soils.

Factors of soil formation

Soils are the products of their environment, as are plants and animals. The characteristics of a soil are determined by (1) the physical and mineral composition of the parent material; (2) climate (temperature and precipitation); (3) topography (the configuration of the landscape or differences in elevation); (4) living organisms (plant and animal life in and on the soil), and (5) time (the length of time that a soil has been subjected to particular environmental conditions). These combined factors affect soil formation and give the soil distinct horizons. A variation in any one factor will result in the formation of a different soil.

PARENT MATERIAL

Most of the soils in the survey area formed from parent materials derived from volcanic rocks, such as mud flows, molten flows through fissures, ejecta, and intrusions. Some of these materials have been moved by water and landslides. The rocks are tuff, breccia, agglomerate, rhyolite, dacite, and basalt. Metamorphism in the tuff and breccia varies from place to place. The highly metamorphosed tuff and breccia are very resistant to weathering. The survey area has been deformed by tilting, broad folding, and faulting to produce a complex rock pattern. Basalt outcrops, as illustrated in figure 4, occur in the survey area. Minor glaciation during the late Pleistocene took place in the headwaters of Highrock, Castle Rock Fork, Hunter, and Black Rock Creeks. A small glacier occupied a few miles of Castle Rock Fork and caused considerable mixing of rock materials. The only true soils that formed in place in the survey area are those on ridgetops. Materials on the slopes are subject to both slow and rapid movement.

Both chemical and physical weathering of the rocks has taken place. Chemical weathering appears to be stronger at lower elevations where the climate is warm and humid. At high elevations where the climate is cooler, physical weathering appears to be dominant. For example, soils derived from basalt parent materials are much redder and finer textured at lower elevations, probably because chemical weathering of the ironbearing materials is more intensive. The translocation and accumulation of silicate clays is more pronounced in soils at the low elevations.

Coyata, Freezener, Hummington, Snowlin, Zing, and other soils derived from basalt and related basic igneous rock are well supplied with plant nutrients and have a high cation-exchange capacity. The rocks are composed chiefly of plagioclase feldspar and olivine, with lesser amounts of pyroxene and amphibole. Acker, Gustin, Vena, and other soils derived from rhyolite and other related acid igneous rocks are not well supplied with plant nutrients. They have a fairly low cation-exchange capacity. The rocks are composed chiefly of quartz and orthoclase feldspar and lesser amounts of pyroxene and amphibole. Boze, Prong, and other soils derived from dacite, andesite, and related igneous rocks are fairly well supplied with plant nutrients and have a medium cation-exchange capacity. The dacite rocks consist chiefly of quartz and plagioclase feldspar and lesser amounts of amphibole and biotite. Pyroxene is in some rocks. The andesite rocks consist chiefly of plagioclase feldspar and lesser amounts of biotite.

Dumont, Straight, and other soils derived from reddish tuff and breccia are well supplied with plant nutrients and have a fairly high cation-exchange capacity. The reddish color of the parent rock is caused by the high content of ferric oxide.

Deatman, Fives, and other soils derived from greenish tuff and breccia are well supplied with nutrients and have a medium cation-exchange capacity. The greenish color of this bedrock is caused by the chlorite minerals. The chlorites are essentially secondary minerals derived from aluminum silicate, biotite, augite, garnet, and feldspar. They may also be a primary constituent of eruptive rocks. The chlorites are believed to be primarily responsible for the cation-exchange capacities in soils derived from green tuff and breccia.

Crater Lake and other soils derived from pumice materials have a very low supply of plant nutrients and a very low cation-exchange capacity. The pumice material is mainly volcanic glass.

Data in table 2 show that the clay in Dumont soils is dominantly kaolinite. Montmorillonite is in the subsoil and increases to moderate amounts with depth. Vermiculite is in the upper 4 inches. The Freezener soil, like the Dumont, contains vermiculite in the upper 30 inches (table 3). The kaolinite content of the Freezener soil is similar to that of the Dumont soil in both amount and distribution with depth. The kaolinite, however, is poorly crystallized in the Freezener soil. Little or no montmorillonite and large amounts of amorphous ma-

TABLE 2.—*X-ray diffraction and differential thermal analysis (DTA) of a Dumont soil*

[Soil survey No. S59Ore-10-1; file No. 60-17B and 60-17A; DTA file No. 60-106]

BSL No.	Horizon	Depth from surface	Content of clay minerals in the clay fraction [1]			Content of minerals in silt fraction (2–50μ) by X-ray diffraction [2]	
			Clay mineral	Amount	Percent (DTA)	Mineral	Amount
		Inches					
591012	A11	0– 4	Vermiculite	x		Quartz	xxxx
			Kaolinite	xx	24	Feldspar	x
591013	A12	4– 9	Vermiculite	x		Quartz	xxxx
			Kaolinite	xxx	42	Feldspar	x
591014	B1	9–14	Montmorillonite	x		Quartz	xxxx
			Vermiculite	x		Feldspar	x
			Kaolinite	xxx	32		
591016	B22t	22–35	Montmorillonite	x		Quartz	xxxx
			Vermiculite	x		Feldspar	x
			Kaolinite	xxxx	44		
591018	B24t	45–52	Montmorillonite	xx		Quartz	xxxx
			Kaolinite	xxxx	37	Feldspar	x
591019	B25t	52–62	Montmorillonite	xxx		Quartz	xxx
						Feldspar	x
			Kaolinite	xxxx	40	Kaolinite	xx
5910110	C	62–72	Montmorillonite	xx		Quartz	xxx
						Feldspar	x
			Kaolinite	xxxx	30	Kaolinite	xx

[1] x means detected; xx, moderate; xxx, abundant; and xxxx, dominant.

[2] Kaolinite is very well crystallized.

terial are present in the Freezener soils, and in this respect they differ from the Dumont soils which contain montmorillonite and little or no amorphous material. The high cation-exchange capacities in the Gustin and Fives soils indicate a considerable amount of the 2 to 1 expanding lattice type clays.

The parent materials and the types of clay play a major role in determining the characteristics of soils in this survey area.

CLIMATE

The general features of climate are described in Part I. The effects of microclimate on soil formation are described here.

Microclimate varies because of differences in elevation, aspect, precipitation, and temperature. Elevations range from about 1,500 to 6,783 feet. Precipitation increases and temperature decreases from lower to higher elevations. These changes are sufficient to cause differences in soil formation and vegetation. Soils at low elevations have a more distinct subsoil than those at high elevations.

The climate is characterized by a single wet-dry cycle. The dry cycle is during summer when soil temperatures are the highest and the wet cycle is during winter when soil temperatures are lowest. This has caused soil formation to be slower than if repeated wet-dry cycles took place throughout the year.

Soils that occupy south-facing slopes are usually drier than those that occupy north-facing slopes because they receive more heat and have a higher rate of evaporation and transpiration. North-facing soils tend to have a thicker and darker colored surface layer but appear to have less profile formation than those on south-facing slopes. This is probably because of slightly cooler temperatures and because less heat is available for chemical and physical weathering. These differences are not sufficient, however, to produce different soils.

TOPOGRAPHY

A general discussion of the landscape is given in Part I. The effect of topography on soil formation is discussed here.

In about 20,000 acres of the survey area slopes are less than 20 percent, and in about 70,000 acres slopes are more than 60 percent. The gradient of many of the steeper slopes is at or beyond the angle of repose. On this terrain the movement of materials downslope retards soil formation. The downslope movement appears to be the least under timber cover. In some soils the downslope movement has been accelerated by fires that destroy cover vegetation.

Surface configuration has influenced soil formation. Soils have the most distinct horizons where slopes are gentle and there is a minimum of erosion. Soils on ridges are slightly eroded, and horizons are not so distinct as those of soils that have gentle slopes. Landslide soils are generally thick, but they have less distinct horizons because the soil-forming processes have been interrupted by mixing of soil and parent materials when the landslide

TABLE 3.—*X-ray diffraction and differential thermal analysis (DTA) of a Freezener soil*

[Soil survey No. S590re-10-3; file No. 61-1; DTA file No. 60-189]

BSL No.	Horizon	Depth from surface	Contents of clay minerals in the clay fraction [1]		
			Clay mineral	Amount	Percent[2] (DTA)
		Inches			
591032	A11	0– 3	Vermiculite	x	10
			Kaolinite	x	
591033	A12	3– 8	Vermiculite	x	
			Kaolinite	x	25
591034	A3	8–15	Vermiculite	x	
			Kaolinite	x	25
591035	B11	15–24	Vermiculite	x	
			Kaolinite	x	25
591036	B12	24–31	Vermiculite	x	
			Kaolinite	x	30
591037	B21	31–38	Kaolinite	xx	30
591038	B22	38–48	Kaolinite	xx	32
591039	B23	48–59	Kaolinite	x	32

[1] x means trace; xx, moderate.

[2] Almost no indication of montmorillonite by DTA. Kaolinite is poorly crystallized. The amorphous material is dominant in this profile.

moves. Where landscape position and slope gradient are otherwise comparable, soils at lower elevations have more distinct horizons than those at high elevations.

LIVING ORGANISMS

A general discussion of vegetation and wildlife is given in Part I. The effect of vegetation and wildlife on soil formation is considered here.

The soil characteristics most affected by vegetation are thickness, structure, organic-matter content of the surface layer, and reaction. The major cover in the survey area is a coniferous forest with small meadowlike openings. These openings support mixed grasses, forbs, sedges, and a few scattered trees. The Whitehorse soils are in meadow openings at elevations above 4,000 feet. Fives soils, dark variant, and Freezener soils, heavy variant, are in lower elevation meadows. The Whitehorse soils have an abundance of roots throughout the upper 30 inches and a high organic-matter content. The residues of the grasses, sedges, and forbs may be resistant to decay. The surface layer in the Whitehorse soils is dark colored and granular. The Freezener variant and Fives variant formed under a grassy vegetation but are now being invaded by ponderosa pine and Oregon white oak. The Fives variant is also being invaded by Douglas-fir.

The clays in the Freezener variant and Fives variant have an expanding 2 to 1 lattice. As the soils dry, wide cracks form in the surface. During storms, water moves through the cracks and transports organic matter from the surface layer to the subsoil.

Organic residue, 1 to 3 inches thick, covers soils in coniferous forests. The reddish color of the subsoil in the Dumont and Freezener soils indicates that iron may have been mobilized and removed from the surface layer by chelation with acid organic components. Data in table 3 show an accumulation of free iron in the B2 and B3 horizons of these soils.

Beaver and other rodents have affected the soils. Rodents have churned the Whitehorse soils in the vicinity of Rattlesnake Mountain to a floury condition. In coniferous forests, however, very little mixing by rodents is evident. Even in harvested areas, where rodent population explosions often take place, very little soil mixing is evident. Sediment that collects in beaver ponds raises the water table in adjacent areas and changes the characteristics and qualities of surrounding soils.

TIME

Soil formation in the survey area began in the Miocene and has been affected by climatic and erosion cycles in the Pliocene and Pleistocene. Airborne pumice deposited during the Pleistocene is more evident in the Crater Lake, Snowlin, Whitehorse, and Hummington soils. The Freezener variant and Fives variant soils are possibly the result of past climatic conditions.

Soil morphology

Soil morphology in the South Umpqua Area is expressed in both faint and moderately prominent horizons. All the soils that have moderate to steep slopes have faint horizonation. Examples are the Straight, Coyata, Prong, and Deatman soils. Examples of soils that have moderate horizonation are the Gustin and Zing soils. Dumont soils have strong horizonation. The recent alluvial soils have very little or no horizonation.

Horizon differentiation in the soils of the South Umpqua Area has been the result of one or more of the following: (1) accumulation of organic matter; (2) addition of materials to the surface, such as volcanic ash; (3) leaching of bases; (4) formation and translocation of clay minerals; and (5) reduction and transfer of iron. In most soils, two or more of these factors have been active in the formation of horizons.

Most of the soils formed under forest vegetation. The Whitehorse soils formed under fern and grass vegetation. Fives soils, dark variant, formed under mixed grass and forest vegetation. In soils that have not been recently logged or burned, organic matter has accumulated in the upper part of the profile, and the A1 horizon is dark colored. This horizon is thin in most places on steep slopes and thick in most places on gentle slopes.

Approximately 6,500 years ago, the eastern and southeastern parts of the survey area were blanketed by airborne pumice. Most of the pumice was subsequently washed from the uplands, but some remained on the surface and was incorporated into the soil. The addition of this material is not identifiable in the morphology of most of the soils. In the Snowlin, Hummington, and Whitehorse soils, however, the pumice is very evident as pebbles throughout the upper part of the profile.

Stone lines are prominent in both the Whitehorse and Snowlin soils and indicate a lithologic discontinuity. The

mineralogical data for a Dumont soil (see table 2) show the mineralogy of the A horizon to be different from that of the B and C horizons. This difference may be caused by the airborne pumice.

Leaching of bases has taken place in all the soils. Fives, Freezener, Dumont, Zing, and Gustin soils have moderately leached profiles and an accumulation of clay in the B horizon. In these soils the A1 and B2 horizons generally contain more bases than the A3 or B1 horizons. This suggests that bases are being recycled to the surface by trees and are being removed, perhaps by leaching, or by roots feeding from the lower part of the A horizon and the upper part of the B horizon.

Mottling is evident in the moderately well drained soils. The Gustin and Zing soils have a B horizon that is gray to grayish brown and light olive brown distinctly mottled with yellowish brown and strong brown. The C horizon also is mottled.

Laboratory data

The physical and chemical characteristics of a few selected soils in the South Umpqua Area are given in tables 4 and 5. The profile of each soil is described in the section "Descriptions of the Soils." Data in the tables are useful to soil scientists in classifying soils and in forming concepts of soil genesis. They are also helpful in estimating the water capacity, erosion potential, fertility, and tilth of soils and in suggesting soil management methods and practices that can be used in multiple-use planning.

All samples analyzed were taken from carefully selected soil pits and are considered representative of the soil material made up of particles less than three-fourths inch in diameter.

The data are placed in two tables because some of the methods used for determining the physical and chemical properties differ; consequently, direct comparisons of soil data cannot and should not be made.

The soil samples used in table 4 were sieved after they were dried, and the rock fragments larger than three-fourths inch in diameter were discarded. The remaining materials were rolled, crushed, and sieved by hand to remove the fragments larger than 2 millimeters in diameter. The material larger than 2 millimeters is recorded in table 4 as the percentage greater than 2 millimeters. All laboratory analyses in table 4 were made on materials that pass the 2 millimeter sieve and are reported on an ovendry basis. In table 5 the soil samples were air dried and passed through a 10-mesh screen. A waiting period of at least 5 days was required before analyses began. This waiting period is considered especially important in determining the potassium content.

In table 4 all the particle-size distribution was determined by use of the pipette method. In table 5 the particle-size distribution was determined mainly by the hydrometer method and partly by the pipette method. Soil reaction (pH) was measured with a glass electrode to obtain the data shown in tables 4 and 5. Organic carbon in tables 4 and 5 was determined by wet combustion, using the Walkley-Black method. Total nitrogen in tables 4 and 5 was determined by the Kjeldahl method.

The cation-exchange capacity in table 5 was determined by using neutral normal ammonium acetate as the salt solution for the extraction of exchangeable cations (*9*). In some soils appreciable amounts of ammonium as well as potassium ions are fixed under moist conditions when ammonium acetate salt solution is used. This does not interfere with the extraction of exchangeable cations, but the value for cation-exchange capacity determined by ammonium saturation is low by amounts equal to the quantity of ammonium fixed. It is important to use a cation that is not subject to fixation for determining the cation-exchange capacity. Of the common cations, sodium is the most suitable. The data on cation-exchange capacity in table 4 were determined by using a sodium-acetate solution of pH 8.2 (*15*). The data on cation-exchange capacity of the soils in tables 4 and 5 are not comparable because different methods were used. The cation-exchange capacity is usually low when ammonium acetate is the salt solution.

Classification of soils

Soils are classified so that we can more easily remember their significant characteristics. Classification enables us to assemble knowledge about the soils, to see their relationship to one another and to the whole environment, and to develop principles that help us to understand their behavior and their response to manipulation. First through classification, and then through use of soil maps, we can apply our knowledge of soils to specified fields and other tracts of land.

Thus, in classification soils are placed in narrow categories that are used in detailed soil surveys so that knowledge about the soils can be organized and used in managing farms, fields, and woodland; in developing rural areas; in engineering work; and in many other ways. Soils are placed in broad classes to facilitate study and comparison in large areas, such as countries and continents.

Two systems of classifying soils have been used in the United States in recent years. The older system was adopted in 1938 (*12*) and later revised (*11*). The system currently used was adopted for general use by the National Cooperative Soil Survey in 1965 (*16*). The current system is under continual study. Therefore, readers interested in development of the current system should search the latest literature available (*10*). In table 6 the soil series of the South Umpqua Area are placed in some categories of the current system.

The current system of classification has six categories. Beginning with the broadest, these categories are order, suborder, great group, subgroup, family, and series. In this system the criteria used as a basis for classification are soil properties that are observable and measurable. The properties are chosen, however, so that the soils of similar origin are grouped together. The classes of the current system are briefly defined in the following paragraphs.

ORDER. Ten soil orders are recognized. They are Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, Spodosols, Alfisols, Ultisols, Oxisols, and Histosols. The properties used to differentiate these soil orders are those that tend to give broad climatic groupings of soils. Two exceptions, the Entisols and Histosols, occur in many different kinds of climate. The four soil orders in the South Umpqua Area are Inceptisols, Mollisols, Alfisols, and Ultisols.

TABLE 4.—*Physical and chemical characteristics of selected*

[Analyses made by Soil Survey Laboratory, Soil Conservation Service,

Series name and location of sample	Depth from surface	Horizon	Particle-size distribution							Particles		
			Very coarse sand (2–1 mm.)	Coarse sand (1–0.5 mm.)	Medium sand (0.5–0.25 mm.)	Fine sand (0.25–0.10 mm.)	Very fine sand (0.10–0.05 mm.)	Silt (0.05–0.002 mm.)	Clay (less than 0.002 mm.)	0.20–0.02 mm.	0.02–0.002 mm.	Greater than 2 mm.
	Inches		*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Dumont: NE¼NE¼ sec. 10, T. 29 S., R. 1 E.	1½–0	O2 [1]	------	------	------	------	------	------	------	------	------	------
	0–4	A11	5. 5	8. 7	4. 7	9. 0	6. 3	47. 7	18. 1	24. 9	34. 3	40
	4–9	A12	3. 6	8. 1	4. 7	8. 6	6. 6	45. 8	22. 6	23. 7	33. 7	35
	9–14	B1	3. 6	7. 3	4. 3	8. 0	5. 8	43. 0	28. 0	22. 7	30. 9	11
	14–22	B21t	4. 5	6. 8	4. 1	7. 0	5. 4	42. 1	20. 1	20. 4	31. 3	5
	22–35	B22t	3. 8	4. 2	3. 1	5. 9	4. 6	35. 3	43. 1	18. 2	25. 3	2
	35–45	B23t	2. 6	3. 6	2. 9	6. 1	5. 0	34. 3	45. 5	17. 5	25. 5	1
	45–52	B24t	1. 8	2. 7	2. 2	4. 8	4. 2	32. 4	51. 9	15. 5	24. 1	1
	52–62	B25t	0. 7	1. 4	2. 4	4. 5	1. 4	33. 5	56. 1	14. 0	24. 1	0
	62–72	C	0. 5	1. 7	2. 7	10. 6	8. 7	37. 9	37. 9	26. 6	27. 2	0
Fives: NW¼SW¼ sec. 2, T. 29 S., R. 2 W.	2–1¼	O1 [1]	------	------	------	------	------	------	------	------	------	------
	1¼–0	O2 [1]	------	------	------	------	------	------	------	------	------	------
	0–4	A1	4. 2	11. 2	7. 0	11. 0	6. 3	39. 4	20. 9	21. 8	30. 0	6
	4–9	A3	1. 8	10. 7	6. 5	11. 7	6. 3	37. 8	25. 2	21. 9	29. 0	3
	9–17	B21t	1. 7	9. 4	6. 0	11. 7	6. 8	33. 7	30. 7	22. 3	24. 9	1
	17–26	B22t	1. 1	9. 5	6. 4	12. 2	7. 2	27. 6	36. 0	22. 3	19. 6	2
	26–38	B23t	1. 4	10. 2	7. 1	13. 1	7. 0	26. 9	34. 3	22. 1	19. 1	9
	38–54	B3t	3. 8	11. 7	7. 9	12. 7	7. 2	26. 8	29. 9	23. 0	18. 1	4
	54–66	C1	4. 0	15. 2	10. 2	15. 8	8. 3	25. 1	21. 4	25. 8	16. 5	7
	66–72	C2	3. 4	12. 8	9. 3	14. 7	8. 1	26. 6	25. 1	24. 2	18. 6	7
Freezener: SE¼SE¼ sec. 21, T. 28 S., R. 2 E.	1–0	O2 [1]	------	------	------	------	------	------	------	------	------	------
	0–9	A1	4. 9	8. 9	3. 2	6. 2	5. 5	47. 1	24. 2	28. 8	32. 5	14
	9–16	B1	1. 0	4. 2	2. 6	6. 0	5. 6	46. 7	33. 9	23. 9	32. 2	2
	16–24	B21t	0. 7	2. 4	1. 9	5. 0	5. 3	41. 2	43. 5	21. 7	28. 1	2
	24–32	B22t	0. 4	2. 7	2. 1	5. 2	5. 0	33. 3	46. 3	20. 7	25. 9	0
	32–45	B23t	0. 5	2. 6	2. 5	5. 6	5. 1	39. 5	44. 2	20. 3	27. 8	0
	45–56	B3t	0. 8	3. 3	3. 0	6. 6	6. 3	41. 5	38. 5	23. 6	28. 3	1
	56–72+	C1	1. 1	4. 1	3. 7	7. 5	7. 2	39. 2	37. 2	25. 5	25. 5	2
Gustin: SE¼SE¼ sec. 23, T. 29 S., R. 1 E.	2–0	O2 [1]	------	------	------	------	------	------	------	------	------	------
	0–5	A1	7. 3	9. 8	5. 3	7. 7	5. 3	48. 4	16. 2	21. 7	36. 2	38
	5–10	A2	7. 8	10. 2	4. 4	6. 9	4. 2	47. 1	19. 4	18. 5	36. 7	24
	10–17	B1	2. 4	7. 0	4. 1	6. 4	4. 1	44. 1	31. 9	19. 6	32. 4	25
	17–23	B21t	2. 2	4. 9	3. 2	5. 7	4. 3	39. 4	40. 3	16. 2	30. 9	3
	23–37	B22t	1. 9	3. 3	2. 3	5. 2	4. 0	31. 7	51. 6	15. 3	23. 6	0
	37–53	B3t	4. 4	5. 4	3. 2	5. 6	4. 8	35. 5	41. 1	16. 0	27. 7	3
	53–66+	C	6. 1	10. 7	6. 3	10. 5	6. 8	33. 6	26. 0	------	23. 6	4

[1] Organic material.

soil series, South Umpqua Area, Oreg.

Riverside, Calif. Dashes in columns mean data were not available]

Moisture held at tension of 15 atm.	Cation exchange capacity	Extractable cations (meq./100 gm.)					Base saturation	Free Fe_2O_3	Organic carbon	Nitrogen	Carbon-nitrogen ratio	Reaction	
		Ca	Mg	H	Na	K						In water 1:1	In potassium chloride 1:1
Percent	*Meq./100 gm.*						*Percent*	*Percent*	*Percent*	*Percent*		*pH*	*pH*
15. 3	33. 4	14. 5	1. 9	18. 5	0. 1	1. 0	49	4. 1	4. 47	0. 189	23. 7	6. 4	5. 3
11. 9	21. 2	4. 6	1. 6	13. 5	. 1	. 7	34	4. 9	1. 50	. 081	18. 5	5. 8	4. 5
11. 8	18. 0	4. 4	1. 2	11. 1	. 1	. 7	37	5. 3	. 69	. 061	11. 3	5. 6	4. 2
12. 9	18. 8	5. 0	2. 1	9. 4	. 4	. 4	46	5. 9	. 41	. 041	10. 0	5. 4	4. 0
17. 0	20. 7	3. 8	2. 2	13. 6	. 1	. 3	32	6. 1	. 20	. 034	5. 9	5. 4	3. 8
18. 0	22. 9	3. 9	2. 4	13. 4	. 1	. 3	33	6. 2	. 11	--------	--------	5. 3	3. 8
21. 8	34. 1	3. 9	2. 8	19. 0	. 1	. 3	27	6. 6	. 08	--------	--------	5. 3	3. 7
30. 1	51. 2	4. 8	5. 0	37. 1	. 1	. 4	22	8. 1	. 12	--------	--------	5. 0	3. 5
26. 9	45. 0	2. 8	5. 7	37. 6	. 1	. 3	19	7. 5	. 18	--------	--------	4. 8	3. 5
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
14. 3	31. 2	14. 5	3. 7	11. 8	. 2	. 5	62	--------	2. 06	. 072	28. 6	5. 7	4. 6
17. 7	31. 3	15. 3	4. 8	10. 3	. 2	. 5	67	--------	1. 11	. 046	24. 1	5. 3	4. 2
20. 2	33. 3	15. 3	6. 8	11. 3	. 1	. 5	67	--------	. 68	. 031	21. 9	5. 2	3. 9
21. 6	33. 6	12. 9	6. 8	12. 9	. 1	. 6	61	--------	. 47	. 026	18. 1	4. 9	3. 7
20. 7	33. 3	11. 7	6. 3	11. 7	. 2	. 5	62	--------	. 24	--------	--------	5. 0	3. 7
19. 6	33. 2	11. 6	7. 1	10. 0	. 3	. 4	66	--------	. 19	--------	--------	5. 0	3. 7
17. 1	28. 3	10. 1	6. 7	10. 2	. 2	. 3	63	--------	. 12	--------	--------	4. 9	3. 7
17. 9	28. 7	10. 2	7. 1	9. 1	. 2	. 4	60	--------	. 17	--------	--------	5. 0	3. 7
14. 9	39. 8	9. 8	3. 1	20. 8	. 1	. 9	40	--------	2. 30	. 096	24. 0	5. 4	3. 9
22. 5	37. 4	10. 2	4. 2	18. 7	. 2	. 8	45	--------	. 77	. 050	15. 4	5. 2	3. 8
24. 9	38. 1	11. 3	4. 8	17. 6	. 2	. 9	49	--------	. 49	. 035	14. 0	5. 2	3. 7
26. 5	37. 8	11. 6	5. 2	16. 4	. 1	1. 1	52	--------	. 23	. 018	12. 8	5. 1	3. 8
26. 8	39. 5	11. 4	5. 3	16. 3	. 1	1. 2	52	--------	. 20	--------	--------	5. 0	3. 7
26. 0	38. 5	10. 8	5. 4	16. 4	. 2	1. 2	52	--------	. 14	--------	--------	5. 1	3. 7
21. 2	36. 5	8. 6	4. 7	17. 6	. 2	1. 2	47	--------	. 20	--------	--------	5. 2	3. 6
15. 3	33. 5	11. 9	2. 3	19. 1	. 1	1. 0	45	2. 3	3. 92	. 172	22. 8	5. 9	4. 8
14. 9	29. 6	8. 2	2. 8	--------	. 1	. 9	--------	2. 6	1. 87	. 112	16. 7	5. 6	4. 2
17. 9	23. 5	10. 1	3. 6	13. 1	. 2	. 5	52	2. 5	. 57	. 055	10. 4	5. 0	3. 8
20. 1	31. 3	10. 2	3. 9	15. 7	. 2	. 4	48	2. 3	. 41	. 040	10. 3	4. 8	3. 5
25. 0	37. 7	13. 5	5. 3	16. 9	. 4	. 4	54	2. 3	. 22	. 023	9. 6	4. 3	3. 2
23. 1	36. 6	15. 7	6. 2	13. 2	. 9	. 4	64	. 9	. 10	--------	--------	4. 2	3. 2
19. 4	31. 1	12. 9	4. 8	11. 6	. 5	. 3	62	1. 9	. 07	--------	--------	4. 9	3. 5

TABLE 5.—*Particle size distribution and chemical analyses of selected*

[Analyses by Oregon State University. Dashes

Soil name and location of sample	Horizon	Depth from surface	Particle-size distribution [1]		
			Sand	Silt	Clay
Acker gravelly loam: NW¼NE¼ sec. 30, T. 28 S., R. 1 E	A1	0–6	------	------	------
	A3	6–11	------	------	------
	B2	16–23	------	------	------
	C1	31–40	------	------	------
Boze gravelly loam: NW¼NW¼ sec. 31, T. 28 S., R. 3 E	A1	0–5	58. 5	28. 1	13. 4
	B2	13–20	47. 4	35. 2	17. 4
	C	27–35	47. 8	36. 9	15. 3
Coyata gravelly loam: SW¼SW¼ sec. 25, T. 29 S., R. 1 W	A1	0–5	41. 0	35. 0	24. 0
	A3	5–9	37. 0	31. 0	32. 0
	B2	13–20	26. 4	36. 3	37. 3
	C	25–40	------	------	------
Crater Lake fine sandy loam: NE¼NW¼ sec. 7, T. 30 S., R. 1 E	A1	0–2	------	------	------
	AC	2–15	------	------	------
	C1	15–21	------	------	------
	C2	21–70	------	------	------
Deatman gravelly loam: SE¼NE¼ sec. 23, T. 29 S., R. 1 E	A1	0–5	51. 4	24. 1	24. 5
	AC	5–13	54. 3	24. 7	21. 0
	C	13–25+	49. 4	17. 1	33. 5
Hummington gravelly loam: NE¼SE¼ sec. 30, T. 27 S., R. 3 E	A1	0–4	------	------	------
	AC	4–10	------	------	------
	B21	10–19	------	------	------
Prong gravelly loam: NW¼SE¼ sec. 31, T. 28 S., R. 3 E	A11	0–6	53. 4	27. 1	19. 5
	A12	6–13	59. 3	28. 1	12. 6
	B2	13–25	54. 4	33. 1	12. 5
Snowlin gravelly loam: [3] SE¼SE¼ sec. 30, T. 27 S., R. 3 E	A11	0–5	39. 4	40. 0	20. 6
	A3	12–20	37. 8	38. 9	23. 3
	IIB1	20–34	25. 1	37. 5	37. 4
	IIB22	39–50	------	------	------
	IIC	60–69	------	------	------
Straight gravelly loam: SW¼NE¼ sec. 34, T. 28 S., R. 1 E	A1	0–5	------	------	------
	B21	5–12	------	------	------
	B22	12–25	------	------	------
Vena gravelly loam: NE¼NW¼ sec. 30, T. 28 S., R. 2 E	A1	0–5	------	------	------
	AC	5–9	------	------	------
Whitehorse loam: NW¼SE¼ sec. 30, T. 27 S., R. 3 E	A11	0–12	38. 6	48. 9	12. 5
	A13	20–29	36. 8	54. 6	8. 6
	IIB2	29–36	33. 2	28. 4	38. 4
	IIC	36–58	37. 0	26. 0	37. 0
Zing loam: SW¼SE¼ sec. 21, T. 28 S., R. 2 E	A1	0–6	------	------	------
	B11	6–12	------	------	------
	B2t	16–28	------	------	------
	B3t	28–36	------	------	------
	C	36–50	------	------	------

[1] Material passing 2-millimeter sieve analyzed by the hydrometer method.
[2] Flame photometer method.
[3] Sand, silt, and clay analyzed by the pipette method.

horizons of some soils mapped in the South Umpqua Area, Oreg.

in columns indicate values were not determined]

Soil acidity (1:1 soil-water paste)	Organic carbon (Walkley-Black method)	Total nitrogen (Kjeldahl method)	Carbon-nitrogen ratio	Phosphorus	Potassium	Cation exchange capacity (NaOAc)	Extractable cations [2] (Meq./100 gm.)				Ca-Mg ratio
							K	Na	Ca	Mg	
pH	*Percent*	*Percent*				*Meq./100 gm.*					
6.1	4.19	0.10	41	16	335	21.5	0.43	0.12	5.2	0.95	5.48
5.8	2.46	.07	35	13	289	17.4	.37	.07	5.0	1.4	3.57
5.3	.65	.03	22	9	203	19.4	.26	.10	4.7	1.85	2.54
5.1	.06	.01	6	6	140	14.3	.18	.08	2.0	.80	2.5
5.6	3.87	.106	36	93	------------	21.1	.51	.04	5.0	.95	5.26
5.6	.66	.040	16	42	------------	21.4	.86	.04	6.7	2.4	2.79
5.4	.21	.016	13	30	------------	24.2	.32	.17	10.3	5.0	2.06
6.1	5.98	.18	33	21	928	36.8	1.19	.19	7.8	1.7	4.60
6.2	3.58	.15	24	14	1,186	36.0	1.52	.16	8.9	2.2	4.05
6.2	1.37	.08	17	8	889	31.1	1.14	.14	8.9	3.0	2.97
6.0	.35	.04	9	16	975	24.5	1.25	.19	7.1	3.5	2.03
6.1	4.88	.218	22	153	------------	28.7	.8	.04	9.7	1.5	6.45
6.4	.81	.056	14	20	------------	15.1	.58	.07	4.3	.95	4.54
6.1	.34	.026	13	5	------------	10.0	.82	.07	2.6	.65	4.0
5.9	.21	.016	13	4	------------	10.6	2.37	.22	4.6	1.1	2.36
6.0	1.75	.08	22	74	686	24.5	.88	.08	10.0	2.5	4.0
5.7	.95	.05	19	29	367	22.7	.47	.12	10.7	2.5	4.28
6.2	.81	.05	16	25	460	28.6	.59	.40	17.4	4.3	4.05
5.4	5.73	.218	26	55	------------	26.9	1.08	.22	7.3	1.45	5.04
5.4	2.90	.151	19	38	------------	23.2	.75	.09	3.9	.95	4.10
5.5	1.10	.081	14	21	------------	18.3	.5	.09	3.0	.65	4.61
5.2	6.16	.147	42	85	------------	28.8	1.39	.04	15.4	2.6	5.90
6.1	2.04	.068	30	39	------------	24.0	.77	.04	11.4	2.4	4.75
6.2	.77	.032	24	20	------------	25.0	.57	.04	15.7	4.9	3.20
5.4	7.10	.348	20	22	------------	38.6	1.14	.30	4.1	1.2	3.42
5.3	3.09	.216	14	18	------------	28.2	.98	.22	.8	.65	1.35
5.2	.62	.053	12	8	------------	39.8	.08	.26	12.5	3.15	3.97
5.0	.24	.036	7	3	------------	47.5	.84	.30	18.7	6.6	2.84
4.9	.29	.047	6	8	------------	41.4	.75	.26	11.1	4.3	2.58
5.9	2.82	.11	26	50	632	18.8	.81	.12	5.0	1.4	3.57
5.9	1.85	.08	23	23	476	17.6	.61	.12	4.3	1.4	3.07
5.7	1.45	.06	24	12	242	16.4	.31	.12	2.6	1.55	1.68
5.6	3.55	.07	51	15	367	16.0	.47	.07	4.3	.95	4.52
6.0	1.40	.05	28	15	289	10.9	.37	.06	1.4	.35	4.00
5.2	5.34	.380	14	17	------------	34.4	2.15	.26	1.6	1.2	1.33
5.0	3.75	.295	13	11	------------	34.2	1.16	.17	.5	.7	.7
4.7	.63	.070	9	8	------------	41.1	.89	.22	1.4	.95	1.47
4.9	.52	.052	10	9	------------	38.8	.78	.26	2.0	.95	2.10
5.8	6.02	.19	32	40	515	41.9	.66	.19	7.6	3.2	2.38
5.6	1.85	.09	21	28	406	34.2	.52	.13	8.9	4.3	2.07
6.6	.44	.02	22	23	335	52.0	.43	.61	22.6	13.7	1.65
6.7	.23	.01	23	11	242	49.5	.31	.61	22.6	13.3	1.70
7.0	.10	.01	10	4	172	46.2	.22	.85	20.6	10.3	2.00

TABLE 6.—*Soil series classified according to the current system of classification*

Series	Family	Subgroup	Order
Acker	Fine-loamy, mixed, mesic	Typic Haploxerults	Ultisols.
Boze	Coarse-loamy, mixed	Typic Cryumbrepts	Inceptisols.
Coyata	Loamy-skeletal, mixed, mesic	Typic Xerumbrepts	Inceptisols.
Crater Lake	Medial, mesic	Typic Vitrandepts	Inceptisols.
Deatman	Fine-loamy, mixed, mesic	Pachic Ultic Haploxerolls	Mollisols.
Dumont	Clayey, kaolinitic, mesic	Typic Haploxerults	Ultisols.
Fives	Fine-loamy, mixed, mesic	Ultic Haploxeralfs	Alfisols.
Fives, dark variant	Fine, mixed, mesic	Pachic Ultic Haploxerolls	Mollisols.
Freezener	Fine, mixed, mesic	Ultic Haploxeralfs	Alfisols.
Freezener, heavy variant	Very fine, mixed, mesic	Ultic Haploxeralfs	Alfisols.
Gustin	Fine, mixed, mesic	Aquultic Haploxeralfs	Alfisols.
Hummington	Loamy-skeletal, mixed	Typic Cryumbrepts	Inceptisols.
Prong	Loamy-skeletal, mixed	Pachic Cryoborolls	Mollisols.
Snowlin	Medial mixed	Andic Cryumbrepts	Inceptisols.
Straight	Loamy-skeletal, mixed, mesic	Dystric Xerochrepts	Inceptisols.
Vena	Loamy-skeletal, mixed, mesic	Dystric Xerochrepts	Inceptisols.
Whitehorse	Medial over loamy, mixed	Typic Cryandepts	Inceptisols.
Zing	Fine, mixed, mesic	Aquultic Haploxeralfs	Alfisols.

Inceptisols have one or more diagnostic horizons that probably formed in a brief period of time and that do not represent significant illuviation, eluviation, or extreme weathering. Coyata and Vena soils are typical of the Inceptisols.

Mollisols have a dark-colored surface layer that shows evidence of clay alluviation in places, and have base saturation of more than 50 percent throughout the solum. Deatman and Prong soils are the Mollisols in the survey area.

Alfisols have a B horizon that shows evidence of clay illuviation. Their surface layer is dark colored and has intermediate base saturation or is light colored and has high or intermediate base saturation. Fives and Freezener soils are typical Alfisols.

Ultisols have a B horizon that shows evidence of clay illuviation. They have low base saturation that decreases with increasing depth. Acker and Dumont soils are the Ultisols in the survey area.

SUBORDER. Each order is divided into suborders on the basis of those soil characteristics that produce classes having the greatest genetic similarity. Suborders have a narrower climatic range than the orders. Criteria for suborders chiefly reflect the presence or absence of waterlogging, or soil differences resulting from the climate or vegetation. An example is Xerults in the order Ultisols.

GREAT GROUPS. Each suborder is divided into great groups on the basis of uniformity in the kinds and sequence of major soil horizons and features. Examples of horizons used to make separations are those in which clay, iron or aluminum, or humus have eluviated or accumulated. Soil temperatures, soil moisture, and major differences in chemical composition (mainly calcium, magnesium, sodium, and potassium) are also used as criteria. An example of the great group is Haploxerults.

SUBGROUP. Each great group is divided into subgroups. One of these subgroups represents the central (typic) segment of the great group. The others, called intergrades, contain soils having properties primarily of the great group but also one or more properties of soils in another great group, suborder, or order. The names of subgroups are derived by placing one or more adjectives before the name of the great group. An example is Pachic Ultic Haploxerolls. This subgroup has a thicker epipedon, or surface layer, and lower base saturation than the typical.

FAMILY. Each subgroup is divided into families, primarily on the basis of properties important to the growth of plants or behavior of soils when used for engineering. Among the properties are texture, mineralogy, reaction, temperature, thickness of horizons, and consistence. An example is the fine-loamy, mixed, mesic family of Typic Haploxerults.

SERIES. The series consists of a group of soils that are formed from a particular kind of parent material and have genetic horizons that, except for texture of the surface layer, are similar in characteristics and in arrangement of layers in the soil profile. Among the characteristics are color, structure, reaction, consistence, and mineralogical and chemical composition.

New soil series must be established and concepts of some established series, especially older ones that have been little used in recent years, must be revised in the course of the soil survey program across the country. A proposed new series has tentative status until review of the series concept at State, regional, and national levels of responsibility for soil classification results in a judgment that the new series should be established. All of the 16 series described in this publication had tentative status when the survey manuscript was sent to the printer. These are the Acker, Boze, Coyata, Crater Lake, Deatman, Dumont, Fives, Freezener, Gustin, Hummington, Prong, Snowlin, Straight, Vena, Whitehorse, and Zing series.

Descriptions of soil series by subgroups

A discussion of the soil series in the South Umpqua Area by subgroups is given in the following paragraphs. A representative profile for each series is described in the section "Descriptions of the Soils."

Typic Cryandepts.—The Whitehorse soils are in this subgroup. These are well-drained soils that formed in

ash and mixed materials. They have low bulk density of the fine-earth fraction of less than 0.85 gram per cubic centimeter, and the exchange complex is dominated by amorphous material in the surface layer. The average annual soil temperature is less than 47° F., and the average summer soil temperature is less than 60° F. where the soil lacks an 0 horizon. These soils have an umbric epipedon at least 20 inches thick.

Typic Vitrandepts.—The Crater Lake soils are in this subgroup. These are well-drained soils that have a bulk density of the fine-earth fraction of less than 0.85 gram per cubic centimeter in the surface layer, and the exchange complex is dominated by amorphous material. The soils formed in alluvium derived from ash. The A horizon is 4 inches or less thick, and the AC or B (cambic) horizons have a moist value of 4 and chromas of 4 to 6.

Dystric Xerochrepts.—Straight and Vena soils are in this subgroup. These are well-drained very gravelly loam soils overlying bedrock at a depth of 20 to 40 inches. They have a light-colored surface layer, lack evidence of clay illuviation, and have a base saturation of less than 60 percent in the upper 30 inches of the profile. Most of the year the soils are moist. They are dry between depths of 12 and 36 inches for 60 consecutive days after June 21st. The Straight soils are dark reddish brown and reddish brown and overlie reddish breccia bedrock. The Vena soils are gray and light gray when dry and overlie rhyolitic tuff bedrock.

Typic Cryumbrepts.—The Boze and Hummington soils are in this subgroup. These are well-drained gravelly loam soils that formed in colluvium weathered from tuff, andesite, diorite, and basalt. The average annual soil temperature is less than 47° F. The average soil temperature in summer is less than 47° F. where there is an O horizon and less than 60° F. without an O horizon. These soils have a very dark brown and very dark grayish-brown A horizon at least 10 inches thick and a base saturation of less than 50 percent. There is no evidence of clay alluviation. Boze soils are gravelly loam throughout and are more than 40 inches deep over bedrock. Hummington soils are more than 35 percent coarse fragments in the B horizon and are 20 to 40 inches deep over basalt bedrock.

Andic Cryumbrepts.—The Snowlin soils are in this subgroup. They are well-drained soils that formed in colluvium weathered from basic igneous rocks and ash. The ash is mostly in the upper 20 inches of the profile. The average annual soil temperature is less than 47° F. The average summer soil temperature is less than 47° F. where there is an O horizon and less than 60° F. without an O horizon. The A horizon is thick and it has a bulk density of the fine-earth fraction of less than 0.95 gram per cubic centimeter and presumably contains amorphous colloidal materials. The base saturation is less than 50 percent, and there is no evidence of clay illuviation.

Typic Xerumbrepts.—The Coyata soils are in this subgroup. These are well-drained very cobbly clay loam soils that formed in colluvium weathered from basalt bedrock. The average annual soil temperature is more than 47° F. The surface layer is dark reddish brown and 10 to 18 inches thick. It has moist chromas of 3 or less. Base saturation is less than 50 percent. There is no evidence of clay illuviation. Most of the year the soils are moist. They are dry between depths of 7 and 20 inches for 60 consecutive days after June 21st.

Pachic Ultic Haploxerolls.—The Deatman and Fives soils, dark variant, are in this subgroup. These are well drained and moderately well drained soils that formed in colluvium weathered from greenish breccia. They have a dark-colored A horizon, are moderately high in base saturation, and lack evidence of clay illuviation. The base saturation is more than 50 percent but less than 70 percent in some part of the upper 30 inches of the profile. The soils have a dark-colored solum. Chromas are 3 or less to depths of 20 inches or more. The average annual soil temperature is more than 47° F. The soils are dry between depths of 7 and 20 inches for 60 consecutive days after June 21st. Deatman soils have a gravelly sandy clay loam subsoil and are 20 to 40 inches deep over bedrock. The Fives soils, dark variant, have a black clayey A horizon and a mottled olive-brown clay B horizon, and are more than 60 inches deep over bedrock.

Pachic Cryoborolls.—The Prong soils are in this subgroup. These are well-drained, moderately deep soils that formed in colluvium weathered from andesite bedrock. They overlie andesite at depths of 20 to 40 inches. They have an average annual soil temperature of less than 47° F. The average soil temperature in summer is less than 60° F. without an O horizon. The soils are dark colored and have moist values and chromas of 3 or less to depths of 16 inches or more. The base saturation is moderately high and generally slightly more than 50 percent throughout the profile. There is no evidence of clay illuviation. Prong soils are loam and sandy loam and are more than 35 percent coarse fragments in the B horizon.

Aquultic Haploxeralfs.—The Gustin and Zing soils are in this subgroup. These are moderately well drained, fine-textured soils that formed in colluvium weathered from rhyolitic tuff and basic igneous rock. These soils have a moderately low base saturation of slightly less than 50 percent in some part of the A horizon (table 4) and a base saturation of more than 50 percent in the B horizon. They have a fine-textured B horizon that shows evidence of clay illuviation and wetness. The soils are moist most of the time, but they are dry between depths of 6 and 20 inches for 60 consecutive days after June 21st. The Gustin soils have a thin dark-colored A1 horizon, a light-colored A2 horizon, and a mottled clayey Bt horizon. In the Zing soils, the A horizon and upper part of the B1 horizon have moist values and chromas of 3 or less. There is no light-colored A2 horizon. The Bt horizon is light olive-brown clay and has a few mottles.

Ultic Haploxeralfs.—Fives, Freezener, and Freezener, heavy variant, soils are in this subgroup. These are well-drained, deep or very deep, moderately fine, fine, and very fine textured soils. The B horizon shows evidence of clay illuviation. Base saturation is more than 35 percent but less than 75 percent in some part of the upper 30 inches of the profile (table 4). Most of the year the soils are moist. They are dry between depths of 7 and 20 inches for 60 consecutive days after June 21st. The Fives soils have an A horizon, 7 inches or less thick, and have moist values and chromas of 3 or less. The B2t horizon is olive-brown clay loam about 30 inches thick. Depth to greenish breccia is 60 inches or more. The Freezener soils are somewhat similar but have colors in

hues of 5YR and redder and have a fine-textured Bt horizon. The base saturation is about 10 to 20 percent lower in the Freezener soils. The Freezener soils, heavy variant, are 60 to 70 percent clay in the Bt horizon. These soils have a thicker, dark-colored A horizon because they are on south-facing slopes and have a cover of mostly grasses and ponderosa pine.

Typic Haploxerults.—The Acker and Dumont soils are in this subgroup. These soils are well-drained, moderately fine textured and fine textured soils that formed in colluvium and residuum weathered from rhyolitic tuff and reddish breccia. The base saturation decreases with depth (tables 4 and 5). It is less than 35 percent at a depth of 50 inches below the upper boundary of the Bt horizon or immediately above the lithic or paralithic contact if shallower. The soils generally are moist, but are dry between depths of 6 and 20 inches for 60 consecutive days after June 21st. The Acker soils have a very dark grayish-brown and dark grayish-brown loam A horizon and a brown clay loam Bt horizon. Depth to rhyolitic bedrock is more than 40 inches. The Dumont soils have a dark reddish-brown and dark-red gravelly loam A horizon and a dark-red clayey Bt horizon. Depth to reddish breccia is more than 60 inches.

Part III: Use and Management of the Soils

This section provides technical information that will aid in managing the soils of the survey area. Use of the soils for the production of timber and forage are discussed in the soil management groups. Also discussed in this section are the capability classification of the soils, use of the soils for grazing, behavior and management of water, use of the soils for recreation, use of the soils as wildlife habitat, and engineering uses of the soils.

Land-use planning, whether public or private, involves the careful evaluation of many factors. The evaluation of each factor is of utmost importance because any one factor may change within relatively short periods of time. Changes may result from improvements in technology, managerial ability, competition of other uses for the same land, capital expenditures, and management. None of these factors can be applied on a sound scientific basis unless the potential ability of the soils to respond to several uses is known.

A soil survey increases the efficiency of planning and management by pointing out the relative potential ability of each soil to produce the desired products. It is also important to know the management practices required to increase yields on those soils that have low potential under natural conditions. It is essential to know the location, acreage, and pattern of occurrence of each soil.

In addition, different kinds of soils react differently to various kinds of use or management. Thus, successful planning and management require information from many sources, one of which is the soil survey. The soil survey contains a great deal of information that is essential to the development of a sound plan for using the soils in the Area.

Soil Management Groups

A soil management group consists of soils that have about the same potential productivity and that need about the same kind of management. Soil management groups are useful in broad planning for maintaining water supplies, growing timber, managing wildlife, managing range, and establishing recreational areas. The soils in each group respond to management in a similar manner for most uses and usually have similar characteristics and qualities. Within some groups, however, a small acreage of soils that differ in management requirements is included.

In the South Umpqua Area, the greatest volume of commercial timber is in stands of Douglas-fir, sugar pine, and ponderosa pine. Lesser amounts of western white pine, incense-cedar, western redcedar, true firs, western hemlock, and mountain hemlock grow throughout the area. Alaska-cedar, lodgepole pine, and knobcone pine are at the highest elevations, but are of little commercial value. Hardwoods are also of little commercial value. Average yields for Douglas-fir, sugar pine, and ponderosa pine were determined by site index measurements on a limited number of plots. These data were supplemented by numerous field observations.

Woodland productivity and site index

Published site curves were used to compute the site index of Douglas-fir (*6*), sugar pine, and ponderosa pine (*7*).

Productivity is indicated by a median site index, according to the following tabulation that shows the range of site indexes for each median index:

Median index	*Range of site indexes*
160	160 or more
150	140 to 159
130	120 to 139
110	100 to 119
90	80 to 99

The site index for any soil will vary by approximately plus or minus 10 feet.

Brush competition refers to invasion and growth of undesirable plants in harvested areas. Competition is *slight* if it does not prevent natural regeneration immediately after clear harvest, but it can become serious if tree regeneration is long delayed. The brush commonly present is ceanothus. Although this brush competes for moisture, it is also a supplier of symbiotic soil nitrogen. So long as the ceanothus does not overtop the young trees, it may be more beneficial than harmful. Ceanothus also furnishes browse for game animals and perhaps reduces browse pressure on tree seedlings. Competition is *moderate* if ceanothus, rhododendron, salal, and other plants appear shortly after clear harvesting. Immediate tree planting is essential to keep the tree seedlings from becoming overtopped. Competition is *severe* where rhododendron, salal, chinquapin, and other sprouting species invade clear harvested areas rapidly and compete with conifer seedlings, even if regeneration is immediate. Delays in regeneration necessitate additional brush control measures for successful establishment of conifers.

Windthrow hazard refers to the effect of wind on surrounding timbered areas after clear harvesting opens up a stand to strong winds. The windthrow hazard is slight

where root penetration is good. Relatively heavy thinning increases the windthrow hazard in the residual stand. The windthrow hazard is *moderate* where the soils are fairly shallow over bedrock. Narrow strips of timber should not be left between cleared areas. The windthrow hazard is *severe* for Douglas-fir on soils that have a clay subsoil and slow permeability that limit penetration of roots. Roots of sugar pine can penetrate a clay subsoil. Roots of ponderosa pine penetrate most clay soils and consequently the windthrow hazard for this tree is slight. Light thinning operations can be carried out in areas of ponderosa pine without damage to the residual stand. Thinnings that open the canopy can cause a severe windthrow hazard in the residual stand.

Equipment limitations are rated as slight, moderate, and severe. *Slight* indicates there is little or no restriction in the kind of equipment or time of the year it can be used. *Moderate* indicates use of equipment is moderately restricted because of slope gradient, soil characteristics, or risk of injury to tree roots. *Severe* indicates use of equipment is severely restricted because of slope gradient, soil characteristics, wetness, or risk of injury to tree roots.

SOIL MANAGEMENT GROUP 1

This group consists of medium-textured soils of the Freezener and Snowlin series. These soils are well drained. Some have moderately fine textured or fine textured lower layers. Depth to basic igneous bedrock is more than 40 inches. Slopes range from 0 to 40 percent. Permeability is moderately slow. Runoff is slow to medium, and the hazard of erosion is slight to moderate.

The site index for Douglas-fir is 160 or higher on all the soils in this group. The site index is also 160 or higher for sugar pine and ponderosa pine on the Freezener soils. Sugar pine and ponderosa pine rarely grow on the Snowlin soils.

Windthrow hazard on these soils is slight. Brush competition is slight on the Freezener soil and moderate on the Snowlin soil. On Snowlin soil vine maple can retard tree regeneration, and weeding may be necessary. Where slopes are 20 percent or less, equipment limitations are slight. Where slopes are 20 to 40 percent, equipment limitations are moderate.

Game browse productivity is high on all the soils. Browse on the Snowlin soil generally is not available to big game animals in winter because of the snowpack.

Most of the soils are suited to the development of recreation areas. The bedrock underlying these soils is suitable for road surfacing and for base materials.

SOIL MANAGEMENT GROUP 2

This group consists of moderately coarse textured to fine-textured soils of the Boze, Crater Lake, Dumont, and Fives series. These soils are well drained. Depth to bedrock is more than 40 inches. Slopes range from 0 to 40 percent. Permeability is moderately rapid to moderately slow. Runoff is slow to medium, and the hazard of erosion is slight to severe.

The site index is 130 for Douglas-fir and 150 for sugar pine on all the soils in this group. The site index for ponderosa pine is 130 on the Fives soil and 150 on the other soils (fig. 12).

The windthrow hazard on these soils is slight to severe. Douglas-fir roots tend to form a mat in the upper part of the clay subsoil of Dumont and Fives soils. The windthrow hazard for Douglas-fir is severe on those soils and slight on the other soils of this group. The windthrow hazard is slight for sugar pine and ponderosa pine because their roots can penetrate deeply in all the soils.

Brush competition is severe on the Boze soils and slight to moderate on the other soils. On the Boze soils unpalatable brush, such as chinquapin and rhododendron, compete with conifers for soil moisture. Equipment limitations are slight to moderate. Tractor logging can cause landslides and erosion on steep slopes. Except during summer, movement of equipment is hindered on the clayey Fives soils. On the other soils that have slopes of 0 to 20 percent, equipment limitations are slight. Equipment limitations are moderate on the steeper soils. The removal or destruction of the thin protective layer on the surface of the Crater Lake soil increases the hazard of excessive erosion. Water bars on roads, trails, landings, and fire lanes and immediate revegetation are needed to help control erosion on all the soils.

Game browse productivity is medium on all of the soils. The main plants for game browse are tall red huckleberry, trailing blackberry, rose, and lupine. Rhododendron, chinquapin, and other kinds of unpalatable brush compete with trees for soil moisture.

The suitability of the soils in this group for development of recreation areas ranges from poor to good.

SOIL MANAGEMENT GROUP 3

This group consists of medium-textured soils of the Acker, Coyata, and Hummington series. These soils are well drained and gravelly. Some have moderately fine textured lower layers. Depth to bedrock is more than 20 inches. Slopes range from 0 to 40 percent. Runoff is slow to medium, and the hazard of erosion is slight to moderate. Permeability is moderately slow to moderately rapid.

The site index for Douglas-fir is 130 on all the soils in this group. The site index for sugar pine and ponderosa pine is 130 on the soils suited to these trees, except that the index for ponderosa pine is 110 on the Acker soils at the highest elevations. The Coyata and Hummington soils are not suited to ponderosa pine, and the Hummington soil is not suited to sugar pine.

The windthrow hazard is slight on the Acker soils. It is moderate on the Coyata and Hummington soils because these soils are less than 40 inches deep and their subsoil is more than 35 percent coarse fragments. Brush competition is moderate on the Coyata and Hummington soils and severe on the Acker soils. Brush, such as chinquapin and rhododendron, competes with conifer seedlings for soil moisture, and weeding may be necessary. Equipment limitations are slight or moderate. After timber is harvested, erosion can be controlled by installing water bars and side drains on spur logging roads, logging landings, skid trails, and fire lanes or by immediate seeding or planting.

Browse for game is sparse on all the soils in this group. A medium amount grows on the Hummington soil at high elevations, but contributes little browse in winter because it is usually covered with snow. Brush of low forage value, such as rhododendron and chinquapin, is dominant in the understory of timber stands and in cleared areas.

Most of the soils are suited to the development of rec-

Figure 12.—**Plantation of ponderosa pine on a Dumont soil in soil management group 2. This soil is well suited to ponderosa pine.**

reational areas. The Hummington soil is poorly suited to this use.

SOIL MANAGEMENT GROUP 4

This group consists of Landslides of Acker, Boze, Dumont, Freezener, Fives, Gustin, and Zing soils in which the horizons are mixed because of past movement. Runoff is slow to medium, and the hazard of erosion is slight to moderate. Permeability is moderate to slow.

Site index for Douglas-fir is 110 on the Gustin materials, 160 on the Freezener materials, and 130 on the other materials. Site index for sugar pine and ponderosa pine is 160 on the Freezener materials and 110 to 150 on the other materials.

The windthrow hazard on Acker, Boze, and Freezener materials is generally slight. It is severe for Douglas-fir on materials that have a clay subsoil because the roots tend to mat on the subsoil and the trees are therefore easily blown down by wind. Brush competition is slight on the Dumont and Freezener materials, moderate on the Fives, Gustin, and Zing materials, and severe on the other materials. Weeding may be necessary on all but the Dumont and Freezener materials. Equipment limitations are moderate. All of these materials are unstable. Clear harvesting of large areas and any excessive soil disturbance can easily cause mass soil movement.

Game browse productivity ranges from low to high. Suitability for development of recreational areas is poor to fair.

SOIL MANAGEMENT GROUP 5

This group consists of medium-textured to fine-textured soils of the Acker, Coyata, Hummington, Dumont, and Fives series. These soils are well drained. Depth to bedrock is more than 20 inches. Slopes range from 40 to 60 percent. Permeability is moderately rapid for the

Hummington soil, moderate for the Coyata soil, and moderately slow for the other soils. Runoff is rapid, and the hazard of erosion is severe.

The site index for Douglas-fir is 130 on all of the soils in this group. The site index for ponderosa pine and sugar pine is 130 on the Acker and Dumont soils. Ponderosa pine is not suited to the Coyata and Hummington soils.

The windthrow hazard is slight on the Acker soil and moderate on Coyata and Hummington soils. It is severe for Douglas-fir on Dumont and Fives soils because the roots tend to mat on top of the clay subsoil.

Brush competition is severe on the Acker soil, slight on Dumont soil, and moderate on the other soils. Equipment limitations are severe because of the very steep slopes. To help control erosion after timber is harvested, water bars are needed on spur logging roads and logging landings and immediate seeding or planting is necessary. Tractor logging causes landslides and erosion.

Game browse productivity is low on Acker and Coyata soils and medium on the other soils. Brush of low forage value for deer is dominant in the understory of timber stands or clear-harvested areas of Acker and Coyata soils.

The soils of this group are poorly suited to the development of recreation areas.

SOIL MANAGEMENT GROUP 6

This group consists of medium-textured soils of the Freezener and Snowlin series. These soils are well drained. In places the lower layers are fine textured. Depth to basic igneous bedrock is more than 40 inches. Slopes range from 40 to 60 percent. Runoff is rapid, and the hazard of erosion is severe. Permeability is moderately slow.

The site index for Douglas-fir is 160 on both kinds of soil. The site index for sugar pine and ponderosa pine is 160 on the Freezener soil, but these trees rarely grow on the Snowlin soil.

Windthrow hazard on these soils is slight. Brush competition is slight on the Freezener soil and moderate on the Snowlin soil. On the Snowlin soil, vine maple and other kinds of brush may retard tree regeneration. Both soils have severe equipment limitations because of steep slopes.

Game browse productivity is high. Browse on the Snowlin soil generally is not available to big game animals in winter because of the snowpack.

The soils of this group are poorly suited to development of recreation areas. The bedrock underlying these soils is suitable for surfacing and base materials for roads.

SOIL MANAGEMENT GROUP 7

This group consists of medium-textured soils of the Coyata and Hummington series. These soils are well drained. Some have moderately fine textured lower layers. These soils average more than 35 percent coarse fragments in the subsoil. Depth to basic igneous bedrock is 20 to 40 inches. Slopes range from 60 to 80 percent and are dissected or smooth and uneven. Runoff is very rapid, and the hazard of erosion is severe. Permeability is moderate to moderately rapid.

The site index is 130 for Douglas-fir on both kinds of soil. The site index for sugar pine is 130 on the Coyata soils; this tree is not suited to the Hummington soils. Ponderosa pine is not suited to any of these soils.

The windthrow hazard on these soils is moderate. Brush competition is moderate, and equipment limitations are severe. Timber harvesting requires extreme care in order to control erosion and landslides. Logging is usually done by cable. The very steep slopes do not permit planting, thinning, and intermediate cutting.

Game browse productivity is medium for Hummington soils and low for the Coyata soils.

The soils of this group are poorly suited to development of recreation areas. The bedrock underlying these soils makes excellent surfacing material for roads, and there are potential quarry sites for this purpose.

SOIL MANAGEMENT GROUP 8

This group consists of soils in the Freezener, Gustin, and Zing series. Except for the well drained Freezener soil, these soils are moderately well drained. All of these soils are fine textured in the subsoil and more than 40 inches deep to bedrock. Slopes range from 0 to 40 percent. Runoff is slow to medium, and the hazard of erosion is slight to moderate. Permeability is slow.

The site index for ponderosa pine is 150 on the Zing soil and 130 on the other soils. Site index for sugar pine is 130 on all the soils. Site index for Douglas-fir is 130 on the Zing soil and 110 on the others.

Windthrow hazard on all of these soils is severe. Douglas-fir roots tend to mat on top of the clay subsoil. Brush competition is slight on the well-drained Freezener soils, heavy variant, and moderate on the other soil. Equipment limitations are moderate because of wetness and high clay content of the soils. Tractor logging causes soil compaction, erosion of skid trails, and landslips. Establishing water bars and seeding or planting cover in bare areas are ways to control erosion.

Game browse productivity is low to medium. Unpalatable brush is plentiful, but it does not affect tree regeneration.

These soils are not well suited to development of recreation areas.

Road cutbanks are unstable. They slide, fill ditches, and plug culverts. Culverts should discharge water into natural drainageways to prevent overloading unstable soil areas. The clay soils require large amounts of base material to stabilize a roadbed. The clay subsoil in cutbanks shrinks on drying and forms small aggregates that roll down the slope and fill the road ditch. Grasses and legumes planted on cutbanks and fill slopes reduce the number of aggregates but do not prevent slipping. Avoiding cuts at the base of benchlike areas in road construction helps prevent slipping of cutbanks. Seeps and springs are common on these soils and cause problems in road drainage.

SOIL MANAGEMENT GROUP 9

This group consists of medium-textured soils of the Prong and Straight series. These soils are well drained and gravelly. Some have moderately coarse textured and medium-textured lower layers. Depth to bedrock is 20 to 40 inches. Slopes range from 20 to 60 percent. Runoff is moderate to rapid, and the hazard of erosion is moderate to severe. Permeability is moderate to moderately rapid.

The site index for sugar pine is 110. The site index

for Douglas-fir is 110 on the Straight soil and 90 on the Prong soil.

The hazard of windthrow on these soils is moderate, and brush competition is moderate to severe. Equipment limitations are moderate to severe.

Game browse productivity is low. These soils are poorly suited to development of recreation areas.

SOIL MANAGEMENT GROUP 10

This group consists of dominantly medium-textured and moderately fine textured soils of the Deatman, Prong, Straight, and Vena series. These soils are well drained. Depth to bedrock is 20 to 40 inches. The subsoil of all but the Deatman soils is more than 35 percent coarse fragments. Slopes are 20 to 100 percent.

The site index for Douglas-fir is 110 on the Straight soils and 90 on the other soils. The site index for sugar pine is 90 on the Deatman and Vena soils and 110 on the Prong and Straight soils.

Runoff is moderate to very rapid, and the hazard of erosion is moderate to severe. Permeability is moderately rapid to moderate.

The windthrow hazard is moderate, and brush competition is moderate to severe. Equipment limitations are severe. Logging is usually done by cable. Tractor logging causes excessive soil erosion and landslides. Intensive erosion control practices are necessary to control erosion after timber is harvested. Spur logging roads, logging landings, fire lanes, and skid trails require water bars, and these soils should be revegetated immediately after harvest to control erosion.

The soils of this group are poorly suited to development of recreation areas. Production of game browse is low.

SOIL MANAGEMENT GROUP 11

This group consists of Alluvial land, Andesite rock land, Tuff rock land, Fives clay, dark variant, and Whitehorse soils. These land types and soils produce little or no commercial timber. Scattered trees grow on Alluvial land and Fives clay, dark variant.

This group provides sources of rock for road surfacing and base construction. It also is useful for scenic beauty and observation points, limited grazing, wildlife, water supply, and recreation.

Capability Grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The groups are made according to the limitations of the soils when used for field crops, the risk of damage when they are used, and the way they respond to treatment. The grouping does not take into acount major and generally extensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to rice, cranberries, horticultural crops, or other crops requiring special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for range, for forest trees, or engineering.

In the capability system, all kinds of soil are grouped at three levels, the capability class, subclass, and unit. These are discussed in the following paragraphs.

Capability Classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use, defined as follows:

Class I soils have few limitations that restrict their use. (No Class I soils in the South Umpqua Area.)

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices. (No Class II soils in the South Umpqua Area.)

Class III soils have severe limitations that reduce the choice of plants, require special conservation practices, or both. (No Class III soils in the South Umpqua Area.)

Class IV soils have very severe limitations that reduce the choice of plants, require very careful management, or both. (No Class IV soils in the South Umpqua Area.)

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife habitat. (No Class V soils in the South Umpqua Area.)

Class VI soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife habitat.

Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture or range, woodland, or wildlife habitat.

Class VIII soils and landforms have limitations that preclude their use for commercial crop production and restrict their use to recreation, wildlife, water supply, or to use for esthetic purposes.

Capability Subclasses are soil groups within one class; they are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few limitations. Class V can contain, at the most, only the subclasses indicated by *w*, *s*, and *c*, because the soils in class V are subject to little or no erosion, though they have other limitations that restrict their use largely to pasture, range, woodland, wildlife habitat, or recreation.

Capability Units are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability

unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-4 or IIIe-6. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph; and the Arabic numeral specifically identifies the capability unit within each subclass.

In the South Umpqua Area, the soils have not been placed in capability units. Instead, suggestions for the use and management of the soils for growing trees are given in the soil management groups.

Use of the Soils for Range

The South Umpqua Area has less than 4,000 acres that is grazed. Nearly 1,000 acres of this grazed area is being invaded by trees. Forage production on the remaining acreage is limited, and cattle often browse on brush in timbered areas and plantations.

Forage suitable for cattle grows on Freezener clay loam, heavy variant, Fives clay, dark variant, and Whitehorse soil. The Freezener variant is being invaded by ponderosa pine, sugar pine, and Douglas-fir and will be completely forested soon. The Fives variant is in ponderosa pine and an understory of grass and probably will remain so. It occupies less than 700 acres in the survey area. Whitehorse soils are scattered throughout areas at high elevations, and some of these areas have been overgrazed, which has caused severe sheet erosion and formation of gullies. The Highrock Creek area has been severely eroded. Sediment from that area has been transported by Highrock Creek to the alluvial fan in Fish Lake. Camping areas are often damaged by livestock, and springs in some areas have been turned into muddy quagmires. Overgrazing on the Whitehorse soils could leave them denuded or possibly convert them into brush fields.

Grazing on roadbanks can destroy the vegetation essential to stabilize the roadbanks.

Water Behavior and Management

Water is an important resource of the South Umpqua Area, and its use and control are of major importance. Measurements at Tiller on the South Umpqua River, about 8 miles downstream from the survey area, show that streamflow has varied from a low of 20 cubic feet per second to a maximum of 46,400 cubic feet per second (*18*). Thus, at flood stage the river has been known to carry 2,320 times as much water as it has during summer low water periods. Data based on 17 years of record indicate that 31.9 inches of precipitation, or more than half the average annual precipitation, leaves the area as streamflow (*18*). Late summer streamflow is dependent upon springs.

Water behavior is determined by geologic composition, topography, drainage patterns, vegetation, and soil characteristics. Water-supplying capability is determined mainly by the amount of precipitation and the ability of the regolith and underlying bedrock to store and yield water to streams.

The geology of the Area is discussed in Part I. The bedrock is both massive and highly fractured, and igneous materials have intruded in many places. The character of the bedrock affects the subsurface movements of water, but quantitative measurements of this effect have not been made in the Area.

The shape and configuration of the landscape influence water behavior. For example, the regolith is deep at the base of steep slopes where soil materials have accumulated. Water moves off the steep slopes into the deep regolith, where it is slowly discharged by springs and seeps into streams. Cove areas in the dissected slopes accumulate water, which is released in springs. Uneven slopes change the speed of surface flow and the sediment-carrying capacity. The South Umpqua River above its confluence with Jackson Creek has an average gradient of 42.5 feet per mile. This steep gradient gives the stream a high sediment-carrying capacity.

The drainage pattern provides information on water movement from the Area. A drainage pattern may be dense if most of the water moves over the surface, or it may be sparse if water moves away through the regolith to streams. The drainage pattern partly depends on the climatic conditions. Data in table 7 show that the number and density of streams in the Boulder Creek area are high. This suggests that most of the water is probably disposed of over the surface in the numerous channels. The massive bedrock in this drainage prevents downward percolation. The drainage pattern in the Buckeye Creek area, however, is poorly developed. This suggests that water moves through the regolith to the main streams. The gentle slopes of soils in the Buckeye Creek drainage favor infiltration of water into the soils.

Recreation Uses and Opportunities

Excellent fishing in the mountain lakes and in some streams attract fishermen to the South Umpqua Area. Hunters come to the survey area for the black-tailed deer, ruffed grouse, mountain quail, and bear. Camping is increasing.

Soil information is one of the important criteria used in establishing and managing recreation areas. It can be used to rate the areas as to their susceptibility to erosion and compaction, water capacity and drainage, infiltration and percolation, and fertility for growing plants. These evaluations can be expressed broadly in terms of durability of the soil. Three ratings, *good*, *fair*, and *poor*, have been used in this soil survey. They are based on the durability of the soil to withstand recreational use and are not intended to show where to locate an area.

A rating of *good* means the soil can withstand intensive recreational use without becoming compacted or seriously eroded. These soils are nearly level or moderately sloping. A rating of *fair* means the soil cannot withstand intensive continuous use without becoming compacted. A rating of *poor* means the soil cannot withstand even light use without excessive compaction and severe erosion. These soils are either in steep terrain or in nearly level areas where wetness is a problem.

Soils in steep terrain are generally shallow and have low available water capacity. The hazard of erosion is severe, and landslides may occur. Wetness is a problem where soils are nearly level. Nearly level soils are generally deep and

TABLE 7.—*Characteristics of some drainages in the South Umpqua Area*

Drainages	Stream orders [1]					
	1	2	3	4	5	6
Sams Creek drainage (2,050 acres):						
Number of streams	4. 00	1. 00	1. 00			
Total length (miles)	2. 75	. 32	3. 90			
Average stream length (miles)	. 69	. 32	3. 90			
Stream-length ratio [2]		2. 10	. 08			
Bifurcation ration [3]		4. 00	1. 00			
Physiographic index [4]		. 52	. 08			
Buckeye Creek drainage above confluence with Twinbuck Creek (6,464 acres):						
Number of streams	73. 00	20. 00	7. 00	1. 00		
Total length (miles)	12. 00	11. 50	10. 30	6. 00		
Average stream length (miles)	. 16	. 57	1. 50	6. 00		
Stream-length ratio [2]		. 28	. 43	. 25		
Bifurcation ratio [3]		3. 60	2. 80	7. 00		
Physiographic index [4]		. 07	. 12	. 03		
Boulder Creek drainage above confluence with Slick Creek (15,680 acres):						
Number of streams	350. 00	68. 00	14. 00	5. 00	1. 00	1. 00
Total length (miles)	54. 00	33. 00	16. 00	8. 80	3. 50	8. 50
Average stream length (miles)	. 15	. 48	1. 10	1. 80	3. 50	8. 50
Stream-length ratio [2]		. 31	. 43	. 61	. 51	. 41
Bifurcation ratio [3]		5. 10	4. 80	2. 80	5. 00	1. 00
Physiographic index [4]		. 06	. 09	. 21	. 10	. 41

[1] Stream orders according to the system developed by R. E. Horton (*5*).

[2] Stream-length ratio (Horton's rl) is the ratio between the average stream length of a given order and the average stream length of the next lower order; that is, $\frac{\text{order 1}}{\text{order 2}}$

[3] Bifurcation ratio (Horton's rb) is the ratio between the number of streams of a given order and the number of streams of the next lower order; that is, $\frac{\text{order 1}}{\text{order 2}}$.

[4] Physiographic index is ratio of rl/rb.

have a medium to high available water capacity. Infiltration is slow to very slow, and the seasonal water table commonly is at depths of 4 feet or less. These soils are easily compacted.

Use of Soils as Wildlife Habitat

Wildlife require an adequate supply of food, water, and cover. The destruction of food and cover plants by overuse or fire can cause a reduction in the number of big game animals, birds, and fish.

The major game animals in the Area are black-tailed deer. The best deer habitat is on the Freezener, Snowlin, and Whitehorse soils. The Whitehorse soils are not suitable as winter habitat because of deep snows. Game is most common on soils that formed from basic igneous material and least common on soils that formed from acid igneous material. The more desirable browse plants grow on soils that formed from basic igneous material rather than on soils formed in acid igneous material. The nutritional value of vegetation is not considered here, but may be highly significant on some soils.

A stomach analysis of the black-tailed deer showed that trailing blackberry is the most important plant in the diet (*3*). The ten most important plants in order of preference are trailing blackberry, salal, grasses, red alder, vine maple, western hemlock, Douglas-fir, huckleberry, fireweed, and western redcedar. Western hemlock rates high because it is primarily a winter starvation food. Most of these plants grow in the South Umpqua Area and are grazed by black-tailed deer. Other browse plants in the Area are several species of ceanothus, willow, mountain ash, salmonberry, and rose.

Soils are rated high, medium, and low in browse productivity, based on the estimated relative amounts of desirable browse plants for deer the soils can produce. These ratings were determined from field observations of vegetation in harvested areas for soils that are timbered, and of natural vegetation for nontimbered soils, such as Fives clay, dark variant, and Whitehorse soils. All nontimbered soils produce more game browse than soils that have a dense timber stand. Soils that have a *high* rating produce the largest quantities of desirable browse. They also produce a high percentage of the more desirable species. Soils that have a *medium* rating produce medium quantities of desirable browse. They produce about equal amounts of desirable and undesirable species. Soils that have a *low* rating produce limited quantities of desirable browse plants but a very large number of undesirable browse plants.

Ratings of browse productivity by soil series

High
- Fives, dark variant
- Freezener
- Snowlin
- Whitehorse

Medium
- Boze
- Crater Lake
- Dumont
- Fives
- Freezener, heavy variant
- Hummington
- Alluvial Land
- Zing

Low
- Acker
- Andesite rock land
- Coyata
- Deatman
- Gustin
- Prong
- Straight
- Tuff rock land
- Vena

Where timber is harvested and openings are created, more food is produced on soils that have medium and high ratings, and increases in deer population can be expected.

Advances in fish management can be made by careful location of roads and careful harvesting in timbered areas. Roads should be located in such a way that sediment is prevented from entering the streams and shade is retained along streams. Siltation of streams often destroys spawning beds and is a serious concern for fish management in the Area. Shade is necessary to keep the water temperature cool in the streams.

Engineering Uses of the Soils

This section provides information of special interest to engineers and others who use soil as structural material or as foundation material upon which structures are built. In this section are those properties of the soils that affect construction and maintenance of roads, pipelines, water storage facilities, and erosion control structures. Among the soil properties most important in engineering are permeability, shear strength, density, shrink-swell potential, water capacity, grain-size distribution, plasticity, and reaction.

Information concerning these and related soil properties is furnished in tables 8, 9, and 10. The estimates and interpretations of soil properties in these tables can be used in—

1. Selecting potential locations for roads, pipelines, and underground cables, and in planning detailed soil investigations at the selected locations.
2. Planning and designing of ponds, reservoirs, and other structures for controlling water and conserving soil.
3. Locating probable sources of gravel or rock suitable for use as construction material.
4. Selecting potential recreational and residential areas.

The engineering interpretations reported here do not eliminate the need for sampling and testing at the site of specific engineering works involving heavy loads and where the excavations are deeper than the depths of layers here reported. Even in these situations, however, the soil information is useful in planning more detailed field investigations and for indicating the kinds of problems that may be expected.

Engineering classification systems

The two systems most commonly used in classifying soil material for engineering are the AASHO system approved by the American Association of State Highway Officials (*1*), and the Unified system (*17*) used by engineers of the Soil Conservation Service, the Department of Defense, and other agencies.

The AASHO system is used to classify soils according to those properties that affect use in highway construction. In this system, a soil is placed in one of seven basic groups ranging from A–1 through A–7 on the basis of grain size distribution, liquid limit, and plasticity index. The groups range from A–1 (gravelly soils of high bearing strength, or the best soils for subgrade or foundation), to A–7 (clayey soils that have low strength when wet). When laboratory data are available to justify a further breakdown, the A–1, A–2, and A–7 groups are divided as follows: A–1–a, A–1–b, A–2–4, A–2–5, A–2–6, A–2–7; and A–7–5, A–7–6. If soil material is near a classification boundary, it is given symbols showing both classes, for example, A–2 or A–4. Within each group, the relative engineering value of a soil material can be indicated by a group index number. Group indexes range from 0 for the best material to 20 for the poorest. The AASHO classification for tested soils, with index numbers in parentheses, is shown in table 8; the estimated classification for most soils mapped in the survey area is given in table 9.

In the Unified system, soils are classified according to particle-size distribution, plasticity, liquid limit, and organic-matter content. Soils are grouped in 15 classes. There are eight classes of coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; six classes of fine-grained soils identified as ML, CL, OL, MH, CH, and OH; and one class of highly organic soils, identified as Pt. Soils on the borderline between two classes are designated by symbols for both classes; for example, CH or MH.

Engineering test data

Table 8 shows the results of engineering tests for eight soil profiles performed by Oregon State University in accordance with standard procedures used by the U.S. Bureau of Public Roads. Both AASHO (*1*) and the Unified classification system (*17*) ratings as explained in the PCA Primer (*8*) are shown here.

Table 8 shows the specific location where samples were taken, the depth of sampling, and the results of tests to determine particle-size distribution and other properties significant in soil engineering.

TABLE 8.—*Engineering test data for*

[Tests performed by Oregon State University in cooperation with the U.S. Department of Commerce, Bureau of Public Roads

Soil name and location of sample	BPR laboratory analysis number	Depth from surface	Moisture density [1] Maximum dry density	Moisture density [1] Optimum moisture	Liquid limit	Plasticity index
		Inches	*Lb./cu. ft.*	*Percent*	*Percent*	
Acker gravelly loam: NW¼NE¼ sec. 30, T. 28 S., R. 2 E.	240–150	0– 6	83	29	46	6
	240–151	16–23	87	28	56	17
Coyata gravelly loam: SW¼SW¼ sec. 25, T. 29 S., R. 1 W.	240–153	25–40	88	27	46	14
Deatman gravelly loam: SE¼NE¼ sec. 23, T. 29 S., R. 1 E.	240–154	13–25	104	21	41	16
Dumont gravelly loam: NE¼NE¼ sec. 10, T. 29 S., R. 1 E.	240– 64	0– 4	91	25	36	7
	240– 67	35–45	94	25	50	11
Fives loam: NW¼SW¼ sec. 2, T. 29 S., R. 2 E.	240– 69	4– 9	93	25	40	12
	240– 70	26–38	87	28	54	18
	240– 71	54–66	91	26	48	13
Freezener gravelly loam: SE¼SE¼ sec. 21, T. 28 S., R. 2 E.	240– 75	0– 9	87	28	43	4
	240– 76	24–32	85	33	62	18
	240– 77	56–72	84	35	55	12
Gustin loam: SE¼SW¼ sec. 23, T. 29 S., R. 1 E.	240–144	0– 5	94	23	39	6
	240–145	23–37	88	28	61	30
	240–146	53–66	93	25	46	13
Snowlin gravelly loam: SE¼SE¼ sec. 30, T. 27 S., R. 3 E.	240–158	0– 5	61	46	72	(4)
	240–159	39–50	84	34	50	10

[1] Based on AASHO Designation: T 99–57, Method A (*1*).

[2] Mechanical analyses according to AASHO Designation T 88–57. Results by this procedure frequently differ somewhat from results obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the soil survey procedure, the fine material is analyzed by the pipette method and the material coarser than 2

selected horizons of major soils

(BPR) in accordance with standard procedures of the American Association of the State Highway Officials (AASHO)]

Mechanical analysis [2]													Classification	
Percentage passing sieve									Percentage smaller than—				AASHO	Unified [3]
1½ in.	1 in.	¾ in.	⅜ in.	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 60 (0.25 mm.)	No. 200 (0.074 mm.)	0.05 mm.	0.02 mm.	0.005 mm.	0.002 mm.		
100	97	93	82.8	74	64	46	41	33	30	22	12.5	7	A-2-5(0)	SM
------	------	100	100	99	99	94	92	82	77	62	47	35	A-7-6(14)	MH
93	82	70	62	60	59	54	51	46	45	37	23	15	A-7-5(4)	GM
100	99	98	96	93	88	67	58	44	40	33	21	12	A-7-6(4)	SC
------	100	100	99	94	79	65	61	52	49	41	25	13	A-4(3)	ML
------	------	100	100	99	98	92	89	81	79	72	59	52	A-7-5(10)	ML-MH
------	------	100	99	99	97	84	77	63	60	49	36	21	A-6(6)	ML
100	99	99	99	98	97	83	76	61	59	51	38	29	A-7-5(10)	MH
------	100	100	99	98	95	76	66	48	45	38	21	16	A-7-5(4)	ML-SM
100	99	99	98	96	85	68	64	57	54	43	27	15	A-5(5)	ML
------	------	--------	100	100	100	95	93	86	83	73	54	43	A-7-5(15)	MH
100	99	97	96	95	93	86	83	74	70	58	39	30	A-7-5(12)	MH
------	------	--------	100	97	89	72	66	56	53	43	22	11	A-4(4)	ML
------	------	--------	100	100	99	91	87	79	76	66	46	38	A-7-5(20)	CH
------	------	--------	100	90	85	64	57	53	42	32	17	11	A-7-5(3)	ML
100	99	98	94	90	87	58	50	34	30	18	6	2	A-2-5(0)	SM
------	------	100	95	92	92	91	89	75	69	54	35	22	A-5(10)	ML-MH

millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analyses used in this table are not suitable for use in naming textural classes for soils.

[3] SCS and BPR have agreed to consider that all soils having plasticity indexes within two points of A-line are to be given a borderline classification. An example of a borderline classification obtained by this use is ML-MH.

[4] Nonplastic.

TABLE 9.—*Estimated soil properties*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil that may differ in the first column. Symbol > means

Soil series and map symbols	Depth to hard bedrock	Depth from surface	Classification: USDA texture	Classification: Unified	Classification: AASHO
	Inches	*Inches*			
Acker: AcC, AcD, AcE	40–60+	0–16	Gravelly loam and loam	ML	A–5
		16–31	Clay loam	MH	A–7
		31–50	Loam	ML	A–4
		50	Rhyolitic tuff bedrock.		
Alluvial land: Al. No estimates. Properties too variable. Overlies gravel at variable depth.					
Andesite rock land: An. No estimates. Properties too variable. Bedrock at or near the surface.					
Boze: BoC, BoD	40–60+	0–60	Gravelly loam	SM or ML	A–4
Coyata: CgD, CgE, CoF. Properties of CpF are too variable to estimate.	20–40	0–20	Gravelly loam and gravelly clay loam.	ML	A–7
		20–40	Very cobbly clay loam [1]	SM or GM	A–7
		40	Basalt bedrock.		
*Crater Lake: CrC, CsD. For Snowlin part of CsD, see Snowlin series.	40–60	0–72	Fine sandy loam	ML or SM	A–5
Deatman: DeD, DrE, DtF. Properties of DsE are too variable to estimate.	20–40	0–25	Gravelly sandy clay loam	SC	A–7 or A–2
		25	Breccia bedrock.		
Dumont: DuC, DuD, DuE	>60	0–9	Gravelly loam	ML or SM	A–4
		9–22	Clay loam	ML	A–7
		22–72	Clay	ML or MH	A–7
Fives: FsC, FsD, FsE	60–120	0–9	Loam	ML	A–6 or A–4
		9–54	Clay loam	MH	A–7
		54–72	Sandy clay loam	ML, MH or SM	A–7
Fives variant: FtD	>60	0–50	Clay	CH	A–7
		50–60	Clay loam	CH or MH	A–7
Freezener: FvC, FvD, FvE	40–60+	0–16	Gravelly loam and clay loam	ML	A–5
		16–56	Clay	MH	A–7
		56–72	Cobbly clay loam [2]	MH	A–7
Freezener variant: FzD	>60	0–12	Clay loam	MH	A–7
		12–47	Clay	CH or MH	A–7
		47–72	Clay loam	MH	A–7
Gustin: GuD	40–60+	0–17	Loam (gravelly in places)	ML or SM	A–4
		17–53	Clay	CH or MH	A–7
		53–66	Loam	ML or SM	A–7
		66	Rhyolitic tuff bedrock.		
Hummington: HbD, HbE, HrF. Properties of HuF are too variable to estimate.	20–40	0–19	Gravelly loam	ML or SM	A–4
		19–31	Very cobbly loam [3]	SM or ML	A–4
		31	Basalt bedrock.		
Landslides: La, Lb, Ld, Le, Lf, Lg, Lz. No estimates. Properties too variable.					

See footnotes at end of table.

significant in engineering

in properties and limitations. For this reason it is necessary to follow carefully the instructions for referring to other series that are listed more than; symbol < means less than]

Liquid limit	Plasticity index	Percentage passing sieve— No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	Permea-bility	Available water capacity	Reaction	Shrink-swell potential	Corrosivity of untreated steel pipe
						Inches/hour	*Inches/inch of soil*	*pH*		
40–50 50–60 35–40	5–10 11–20 5–10	85– 95 95–100 85– 95	80– 90 90–100 80– 90	70– 80 90–100 70– 80	55–70 75–85 55–70	0. 63–2. 00 0. 2 –0. 63 0. 63–2. 00	0. 14–0. 16 0. 17–0. 20 0. 14–0. 16	5. 5–6. 0 5. 0–5. 5 4. 5–5. 1	Low Low Low	Moderate. Moderate. Moderate.
35–40	5–10	55– 80	50– 75	45– 70	35–55	0. 63–2. 00	0. 12–0. 15	5. 1–6. 0	Low	Moderate.
40–50	10–15	70– 80	65– 75	60– 60	50–60	0. 63–2. 00	0. 14–0. 18	5. 6–6. 5	Low	Moderate.
40–50	10–15	55– 75	50– 70	45– 65	35–50	0. 63–2. 00	0. 07–0. 12	5. 6–6. 5	Low	Moderate.
41–50	0–5	100	100	70– 90	40–65	2. 0 –6. 3	0. 20–0. 30	5. 6–6. 5	Low	Low.
40–50	10–20	80– 95	75– 90	60– 85	30–45	0. 63–2. 0	0. 12–0. 15	5. 6–6. 5	Low	Low.
30–40 40–50 45–60	5–10 10–15 10–20	65– 85 90–100 90–100	60– 80 90–100 90–100	55– 70 80– 95 85– 95	35–60 65–80 70–85	0. 63–2. 0 0. 63–2. 0 0. 2 –0. 63	0. 11–0. 14 0. 17–0. 21 0. 13–0. 16	5. 6–6. 5 5. 1–6. 0 4. 5–5. 5	Low Low Moderate	Moderate. Moderate. High.
30–40 50–60 40–55	5–15 15–20 10–15	95–100 95–100 95–100	90–100 90–100 90–100	80– 90 80– 90 70– 85	55–65 55–70 45–55	0. 63–2. 0 0. 2 –0. 63 0. 2 –0. 63	0. 15–0. 18 0. 17–0. 21 0. 13–0. 16	5. 1–6. 0 4. 5–5. 5 4. 5–5. 5	Low Low Low	Moderate. Moderate. Moderate.
50–60 50–60	25–35 20–30	100 100	100 100	90–100 90–100	80–95 65–70	0. 06–0. 2 0. 2 –0. 63	0. 14–0. 16 0. 19–0. 21	5. 6–6. 6 6. 1–7. 3	High High	High. High.
40–50 55–65 50–60	5–10 15–25 10–20	85– 95 95–100 90–100	80– 90 95–100 85–100	65– 75 90–100 80– 90	60–70 80–90 70–80	0. 63–2. 0 0. 2 –0. 63 0. 2 –0. 63	0. 14–0. 18 0. 16–0. 18 0. 18–0. 21	5. 1–6. 0 5. 1–5. 5 5. 1–5. 5	Low High Low to moderate.	High. High. High.
50–60 50–60 50–60	11–20 20–30 10–20	100 100 100	100 90–100 90–100	90–100 85–100 80–100	70–80 70–95 65–80	0. 2 –0. 63 0. 06–0. 2 0. 2 –0. 63	0. 17–0. 20 0. 14–0. 16 0. 17–0. 20	5. 6–6. 0 5. 6–6. 0 5. 1–6. 0	Moderate High Moderate	High. High. High.
30–40	5–10	65–100	60– 95	55– 90	35–70	0. 63–2. 0	0. 16–0. 18	4. 5–6. 0	Low to moderate.	High.
55–65 40–50	25–35 10–15	95–100 80– 95	95–100 75– 90	85– 95 60– 85	80–90 40–65	0. 06–0. 2 0. 63–2. 0	0. 13–0. 16 0. 16–0. 18	4. 0–5. 0 4. 5–5. 0	High Moderate	High. Moderate.
30–40 30–40	5–10 5–10	70– 85 55– 80	65– 80 50– 75	55– 75 45– 70	40–60 35–55	2. 0 –6. 3 2. 0 –6. 3	0. 12–0. 16 0. 06–0. 11	5. 1–5. 5 5. 1–5. 5	Low Low	High. Moderate.

TABLE 9.—*Estimated soil properties*

Soil series and map symbols	Depth to hard bedrock	Depth from surface	Classification: USDA texture	Classification: Unified	Classification: AASHO
	Inches	*Inches*			
Prong: PgD, PgE, PgF, PrF. Properties of PoF are too variable to estimate.	20–40	0–13	Gravelly loam and gravelly sandy loam.	SM or GM	A–2 or A–4
		13–25	Very gravelly sandy loam	GM	A–2
		25	Andesite bedrock.		
Snowlin: SnC, SnD, SnE	>50	0–20	Gravelly loam	SM or ML	A–5
		20–69	Cobbly clay loam and clay loam.[5]	ML or MH	A–5
Straight: StD, StE, StF. Properties of SuF are too variable to estimate.	20–40	0–25	Very gravelly loam [6]	GM	A–2 or A–4
		25	Breccia bedrock.		
Tuff rock land: Tv. No estimates. Properties too variable. Bedrock at or near the surface.					
Vena: VeE, VrE, VrF, VrG. Properties of VvF are too variable to estimate.	20–40	0–21	Very gravelly loam [7]	GM	A–2 or A–4
		21	Rhyolitic tuff bedrock.		
Whitehorse: WhC, WhD	40–60+	0–29	Loam	ML	A–4
		29–58	Gravelly clay loam	ML or MH	A–7
		58	Basalt bedrock.		
Zing: ZgC	>60	0–16	Loam and clay loam	ML	A–7
		16–36	Clay	MH or CH	A–7
		36–50	Clay loam	ML	A–7

[1] 15 to 40 percent cobblestones.
[2] 50 to 60 percent cobblestones and stones.
[3] 30 to 55 percent cobblestones.
[4] Nonplastic.

TABLE 10.—*Engineering*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The soils for referring to other series that

Soil series and map symbol	Suitability for use as—: Road fill (subgrade)	Suitability for use as—: Subbase	Suitability as a source of—: Topsoil
Acker: AcC, AcD, AcE	Fair to poor: A–4, A–5, and A–7 material.	Poor: excessive fines	Fair: excessive gravel in surface layer.
Alluvial land: Al. No interpretations. Onsite investigation necessary.			
Andesite rock land: An	Unsuited	Good	Unsuited
Boze: BoC, BoD	Fair: A–4 material	Fair: excessive fines	Fair: excessive gravel to bedrock.
Coyata: CgD, CgE, CoF. Properties of CpF are too variable to interpret.	Poor: A–7 material	Poor: excessive fines and cobblestones.	Fair: excessive gravel

significant in engineering—Continued

Liquid limit	Plasticity index	Percentage passing sieve— No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	Permeability	Available water capacity	Reaction	Shrink-swell potential	Corrosivity of untreated steel pipe
						Inches/hour	*Inches/inch of soil*	*pH*		
(4)	----------	55– 80	50– 75	40– 60	25–45	2. 0 –6. 3	0. 08–0. 10	5. 1–6. 5	Low	Moderate.
(4)	----------	20– 55	15– 50	10– 35	5–20	2. 0 –6. 3	0. 05–0. 07	5. 6–6. 5	Low	Low.
60–75 45–55	(4) 5–10	70– 85 85– 95	65– 80 80– 90	55– 75 70– 90	35–60 55–70	0. 63–2. 0 0. 2 –0. 63	0. 13–0. 16 0. 14–0. 20	5. 1–5. 5 4. 5–5. 5	Low Low	High. High.
(4)	(4)	45– 75	40– 70	35– 65	25–50	0. 63–2. 0	0. 08–0. 10	5. 6–6. 0	Low	Low to moderate.
(4)	(4)	50– 65	45– 60	40– 55	25–40	0. 63–2. 0	0. 07–0. 09	5. 1–6. 0	Low	Low.
30–40 40–55	5–10 11–20	95–100 65– 75	95–100 60– 70	80– 95 25– 65	60–75 50–60	0. 63–2. 0 0. 2 –0. 63	0. 16–0. 18 0. 14–0. 18	4. 5–5. 5 4. 5–5. 0	Low Low	High. High.
40–50 50–65 40–50	10–15 20–35 10–15	95–100 95–100 95–100	95–100 95–100 95–100	85–100 85–100 85–100	65–80 70–95 65–80	0. 2 –0. 63 0. 06–0. 2 0. 63–2. 0	0. 18–0. 20 0. 14–0. 16 0. 19–0. 21	5. 1–6. 0 6. 6–7. 3 6. 6–7. 3	Moderate High Moderate	High. High. High.

[5] 10 to 30 percent cobblestones.
[6] 10 to 40 percent cobblestones.
[7] 5 to 15 percent cobblestones.

interpretations for specified uses

in such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions appear in the first column of this table]

Suitability as a source of—Con. Rock	Soil features affecting— Reservoir area	Embankment	Cut bank stability	Hydrologic group
Poor: rhyolitic tuff	Moderately slow permeability; 40 to 60 inches to tuff.	Moderate permeability when compacted; moderate piping hazard.	Moderate	B
Good: hard andesite	Mainly rock	Mainly rock	---------------	D
Good: hard andesite or diorite.	Moderate permeability; 40 to more than 60 inches to bedrock.	Moderate permeability when compacted; moderate to high piping hazard.	High	B
Good: basalt	Moderate permeability; 20 to 40 inches to bedrock.	Low to moderate permeability when compacted; 20 to 40 inches to bedrock.	High	C

TABLE 10.—*Engineering*

Soil series and map symbol	Suitability for use as—		Suitability as a source of—
	Road fill (subgrade)	Subbase	Topsoil
*Crater Lake: CrC, CsD For Snowlin part of CsD, see Snowlin series.	Fair: A–5 material	Fair: excessive fines	Good
Deatman: DeD, DrE, DtF Properties of DsE are too variable to interpret.	Fair to poor: A–7 or A–2 material.	Poor: excessive fines	Fair: some gravel
Dumont: DuC, DuD, DuE	Poor: A–7 material	Poor: excessive fines	Fair: excessive gravel in surface layer and excessive fines in subsoil.
Fives: FsC, FsD, FsE	Poor: A–7 material	Poor: excessive fines	Good
Fives variant: FtD	Poor: A–7 material	Poor: excessive fines	Poor: excessive fines.
Freezener: FvC, FvD, FvE	Fair to poor: A–5 and A–7 material.	Poor: excessive fines	Fair: excessive gravel in surface layer.
Freezener variant: FzD	Poor: A–7 material	Poor: excessive fines	Poor: excessive fines
Gustin: GuD	Poor: A–7 material	Poor: excessive fines	Poor: excessive fines
Hummington: HbD, HbE, HrF Properties of HuF are too variable to interpret.	Fair: A–4 material	Fair: excessive cobblestones.	Poor: excessive coarse fragments.
Landslides: La, Lb, Ld, Le, Lf, Lg, Lz. No interpretations. Onsite investigation necessary. For soils in these units, refer to their respective series.			
Prong: PgD, PgE, PgF, PrF Properties of PoF are too variable to interpret.	Good to fair: A–2 or A–4 material.	Good	Poor: excessive gravel
Snowlin: SnC, SnD, SnE	Fair: A–5 material	Fair: excessive fines	Fair: some coarse fragments in surface layer.
Straight: StD, StE, StF Properties of SuF are too variable to interpret.	Fair to good: A–2 or A–4 material.	Fair: excessive soft coarse fragments.	Poor: excessive gravel and cobblestones.
Tuff rock land: Tv	Unsuited: too soft	Poor: too soft	Unsuited
Vena: VeE, VrE, VrF, VrG Properties of VvF are too variable to interpret.	Fair to good: A–2 or A–4 material.	Fair: rhyolitic tuff	Poor: excessive gravel and cobblestones.
Whitehorse: WhC, WhD	Poor to fair: A–7 lower part A–4 upper part material.	Poor: excessive fines	Good
Zing: ZgC	Poor: A–7 material	Poor: excessive fines	Fair: thin surface to excessive fines.

interpretations for specified uses

Suitability as a source of—Con.	Soil features affecting—		Cut bank stability	Hydrologic group
Rock	Reservoir area	Embankment		
Poor: thick overburden	Moderately rapid permeability	Moderate permeability when compacted; high piping hazard.	Moderate	B
Poor: breccia and tuff	Moderate permeability; 20 to 40 inches to bedrock.	Low to moderate permeability when compacted; 20 to 40 inches to bedrock.	Moderate	C
Poor: tuff and breccia	Moderately slow permeability; 60 inches to bedrock.	Low to moderate permeability when compacted.	Moderate	B
Poor: tuff and breccia	Moderately slow permeability; more than 60 inches to bedrock.	Low to moderate permeability when compacted.	Low	B
Poor: breccia	Slow permeability; more than 60 inches to bedrock.	Low permeability when compacted.	Low	C
Good: basalt	Moderately slow permeability; 40 to more than 60 inches to bedrock.	Low to moderate permeability when compacted.	Low to moderate.	B
Good: basalt	Slow permeability	Low permeability when compacted.	Low	C
Poor: breccia and tuff	Slow permeability	Low and moderate permeability when compacted.	Low	C
Good: basalt	Moderately rapid permeability; 20 to 40 inches to bedrock.	Moderate permeability when compacted; moderate piping hazard.	Moderate	C
Good: basalt	Moderately rapid permeability; 20 to 40 inches to bedrock.	Moderate permeability when compacted; moderate piping hazard.	Moderate	C
Good: basalt	Moderately slow permeability	Low to moderate permeability when compacted; high piping hazard.	High	B
Poor: breccia	Moderate permeability	Moderate permeability when compacted.	Moderate	C
Poor: breccia	Mainly rock	Mainly rock		D
Fair: rhyolitic tuff	Moderate permeability	Moderate permeability when compacted.	Moderate	C
Good: basalt	Moderately slow permeability	Moderate to low permeability when compacted; moderate piping hazard.	Moderate	B
Poor: thick overburden to basalt.	Slow permeability	Low to moderate permeability when compacted.	Low	C

Maximum dry density is the maximum unit dry weight of the soil when it has been compacted at optimum moisture content by the prescribed method of compaction. The moisture content that gives the highest dry unit weight is called the optimum moisture for the specific method of compaction.

Mechanical analyses show the percentages, by weight, of soil particles that would pass sieves of specified sizes. Sand and other coarser materials do not pass through the No. 200 sieve. Silt and clay pass through the No. 200 sieve. Silt is that material larger than 0.002 millimeter in diameter that passes through the No. 200 sieve, and clay is that fraction passing through the No. 200 sieve that is smaller than 0.002 millimeter in diameter. The clay fraction was determined by the hydrometer method, rather than by the pipette method most soil scientists use in determining the clay content in soil samples.

Liquid limit and plasticity index indicate the effect of water on the strength and consistence of soil material. As the moisture content of a clay soil is increased from a dry state, the material changes from a semisolid to a plastic state. If the moisture content is further increased, the material changes from a plastic to a liquid state. The plastic limit is the moisture content at which the soil material passes from semisolid to plastic. The liquid limit is the moisture content at which the material changes from plastic to liquid. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which a soil material is plastic.

Estimated properties of the soils

Table 9 provides estimates of soil properties important to engineering. The estimates are based on field classification and descriptions, physical and chemical tests of selected representative samples, and on detailed experience obtained in working with the individual kind of soil in the survey area.

USDA texture is determined by the relative proportions of sand, silt, and clay in soil material that is less than 2.0 millimeters in diameter. Sand, silt, clay, and some of the other terms used in the USDA textural classification are defined in the Glossary at the back of this survey.

Permeability, as used in table 9, relates only to movement of water downward through undisturbed and uncompacted soil. Lateral seepage or changes in properties resulting from use of the soils are not considered. The estimates are based on texture, structure, density, and porosity of the soil.

Available water capacity is the amount of capillary water in the soil available for plant growth after all free water has drained away.

Reaction is the degree of acidity or alkalinity of a soil, expressed as a pH value. The pH value and relative terms used to describe soil reaction are explained in the Glossary.

Shrink-swell potential is an indication of the volume change to be expected of the soil material as moisture content changes. Shrinking and swelling of soils cause damage to building foundations, roads, and other structures. A high shrink-swell potential indicates hazards to the maintenance of structures constructed in, on, or with such materials.

Corrosivity, as used here, indicates the potential danger to uncoated steel through chemical action that dissolves or weakens the structural material. Structural materials may corrode when buried in soil, and a given material corrodes in some kinds of soil more rapidly than in others. Extensive installations that intersect soil boundaries or soil horizons are more likely to be damaged by corrosion than are installations entirely in one kind of soil or soil horizon.

A seasonal high water table is not an engineering problem on most soils of the area.

Interpretations of engineering properties of the soils

Table 10 rates the soils according to their suitability as a source of road fill, topsoil, and rock for road building. It also designates soil features that affect the suitability of the soils for reservoir areas and embankments, rates cutbank stability, and shows the hydrologic group to which each soil has been assigned.

Estimates of suitability of the soils for use as road fill (subgrade) and subbase are based on the AASHO classification and on judgment of the appropriate soil properties. The ratings are *good*, *fair*, *poor*, or *unsuited.*

Topsoil is rated as *good*, *fair*, *poor*, or *unsuited* for use on sloping areas, shoulders of roads, and along ditches for growth of vegetation.

Estimates of the suitability of rock underlying the soils for crushing and use in road building are based primarily on the kind and hardness of the rock. The ratings are *good*, *fair*, and *poor.*

None of the soils consists dominantly of sand or clean gravel, nor are any of the soils underlain by such material within a few feet of the surface.

Reservoir areas are affected mainly by seepage loss of water. The permeability of undisturbed soil and depth to bedrock are the common features given.

Reservoir embankments serve as dams. Features of the subsoil and substratum are important to the use of soils for constructing embankments. The main features given are compacted permeability, piping hazard, and depth to bedrock.

Cut bank stability refers to the ability of the exposed soil to resist sliding, slumping, or eroding. Ratings used are *high*, *moderate*, and *low.*

Hydrologic soil groups are used in watershed planning to estimate runoff from rainfall. Soil properties are considered that influence the minimum rate of infiltration obtained for a bare soil after prolonged wetting. These properties and qualities are: depth to the seasonal high water table, intake rate and permeability after prolonged wetting, and depth to very slowly permeable layers. The influence of ground cover is treated independently and is not considered in hydrologic soil groupings.

The Soil Conservation Service classifies soils into four hydrologic groups—A, B, C, and D. The grouping is based on the intake of water in a soil without protective vegetation after the soil is wet and has swelled. The four groups are described as follows:

Group A. Low runoff potential.—Soils having high (rapid) infiltration rates even when thoroughly wetted; consisting chiefly of deep, well-drained to excessively drained sands or gravel. These soils have a high rate of water transmission.

Group B. Moderately low runoff potential.—Soils having moderate infiltration rates when thoroughly wetted; consisting chiefly of moderately deep to deep, moderately well drained to well drained soils that have moderately fine to moderately coarse textures and moderately slow to moderately rapid permeability. These soils have a moderate rate of water transmission.

Group C. Moderately high runoff potential.—Soils having slow infiltration rates when thoroughly wetted; consisting chiefly of soils having a layer that impedes downward movement of water, soils of moderately fine to fine texture, soils having slow infiltration caused by salts or alkali, or soils having a moderate water table. These soils are somewhat poorly drained soils or well drained and moderately well drained soils having slowly and very slowly permeable layers (fragipan, hardpan, hard bedrock, and the like) at moderate depth (20 to 40 inches).

Group D. High runoff potential.—Soils having very slow infiltration rates when thoroughly wetted; consisting chiefly of clay soils having a high shrink-swell potential, soils having a permanent high water table, soils having a claypan or clay layer at or near the surface, soils having very slow infiltration caused by salts or alkali, and shallow soils over nearly impervious material. These soils have a very slow rate of water transmission.

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Glossary

Acid igneous rock. An igneous rock in which quartz, alkaline feldspars, and muscovite and other minerals high in silica are dominant.

Acidity, soil. See Reaction, soil.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as crumb, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Aspect (forestry). (1) The direction toward which a slope faces; the exposure. (2) The general physical appearance of a plant type.

Available water capacity (also termed available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. Because laboratory data were not available for soils of the survey area, information about soils of similar texture were used to estimate the moisture capacity. The estimated weight percent of gravel and cobblestones in the soil was subtracted from the depth to bedrock in calculating the amount of available water.

Basic igneous rock. An igneous rock in which minerals comparatively low in silica and rich in amphiboles, the pyroxenes, biotites, olivine, and similar metallic bases, are dominant.

Cirque basin. A gently sloping area at the base of the cirque headwall.

Cirque headwall. A deep, steep-walled amphitheater in a mountain, caused by glaciation.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Colluvium. Soil material, rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart, rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard and brittle; little affected by moistening.

Creep, soil. The downward movement of masses of soil and soil material, primarily through the action of gravity. The move-

ment is generally slow and irregular. It occurs most commonly when the lower part of the soil is nearly saturated with water, and it may be facilitated by alternate freezing and thawing.

Dacite. The extrusive equivalent of quartz diorite. All of the principal minerals, such as andesine, obligoclase, quartz, pyroxene, and hornblende, can be present as phenocrysts in a glassy or finely crystalline groundmass of alkaline feldspars and silica minerals.

Dendritic. Branched like a tree or shrub; used to describe a river or natural drainage system.

Genesis, soil. The manner in which a soil originates. Refers especially to the processes initiated by climate and organisms that are responsible for the development of the solum, or true soil, from the unconsolidated parent material, as conditioned by relief and age of landform.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

O horizon.—The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.

A horizon.—The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4) by some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock usually underlies a C horizon, but may be immediately beneath an A or B horizon.

pH value. A numerical means for designating relatively weak acidity and alkalinity in soils. A pH value of 7.0 indicates precise neutrality; a higher value, alkalinity; and a lower value, acidity.

Ped. See aggregate, soil.

Permeability, soil. The quality of a soil horizon that enables water or air to move through it. Terms used to describe permeability are as follows: *Very slow, slow, moderately slow, moderate, moderately rapid, rapid,* and *very rapid.*

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour," soil is one that gives an acid reaction. In words, the degrees of acidity or alkalinity are expressed thus:

	pH		*pH*
Extremely acid	Below 4.5	Neutral	6.6 to 7.3
Very strongly acid	4.5 to 5.0	Mildly alkaline	7.4 to 7.8
Strongly acid	5.1 to 5.5	Moderately alkaline	7.9 to 8.4
Medium acid	5.6 to 6.0	Strongly alkaline	8.5 to 9.0
Slightly acid	6.1 to 6.5	Very strongly alkaline	9.1 and higher

Revegetation. The reestablishment or improvement of a plant cover, either naturally or through reseeding or transplanting.

Sand. Individual rock or mineral fragments in soils having diameters ranging from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Silt. Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay.

Solum. The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in mature soil includes the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristic of the soil are largely confined to the solum.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal). *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are (1) *single grain* (each grain by itself, as in dune sand) or (2) *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. Technically, the part of the soil below the solum.

Surface layer. A term used in nontechnical soil descriptions for one or more layers above subsoil. Includes A horizon and part of B horizon; has no depth limit.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness. The plowed layer.

Sustained water yield. The amount of water that the soil and underlying material will store and release slowly through springs and seeps to maintain a sustained flow in streams; in contrast to flood yield and rapid surface runoff following storms or periods of rapid snowmelt.

Terrace (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, lake, or the sea. Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to overflow. Marine terraces were deposited by the sea and are generally wide.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportions of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Variant, soil. A soil having properties sufficiently different from those of other known soils to suggest establishing a new soil series, but a soil of such limited known area that creation of a new series is not believed to be justified.

Water bar. A water bar is a device to divert water flowing down the road to a disposal point on the downslope side of the road. Examples are a ridge or rise placed across the road, or culverts placed across the road with a camber built into the road to provide drainage.

GUIDE TO MAPPING UNITS

For complete information about a mapping unit, read both the description of the mapping unit and that of the soil series to which it belongs. Use and management of the soils for woodland, range, recreation, and wildlife are described on pages 42 to 49. The capability grouping is explained on page 46. Other information is given in tables as follows:

Acreage and extent of soils, table 1, page 13.
Physical and chemical analyses, tables 2, 3, 4, and 5, pages 33 through 39.
Engineering uses of soils, tables 8, 9, and 10, pages 50 through 57.

Map symbol	Mapping unit	Described on page	Soil management group Number	Soil management group Page	Capability subclass
AcC	Acker gravelly loam, 0 to 20 percent slopes	13	3	43	VIe
AcD	Acker gravelly loam, 20 to 40 percent slopes	12	3	43	VIe
AcE	Acker gravelly loam, 40 to 60 percent slopes	13	5	44	VIIe
Al	Alluvial land	14	11	46	VIw
An	Andesite rock land	14	11	46	VIIIs
BoC	Boze gravelly loam, 0 to 20 percent slopes	14	2	43	VIe
BoD	Boze gravelly loam, 20 to 40 percent slopes	14	2	43	VIe
CgD	Coyata gravelly loam, 20 to 40 percent slopes	15	3	43	VIe
CgE	Coyata gravelly loam, 40 to 60 percent slopes	15	5	44	VIIe
CoF	Coyata rocky loam, 60 to 80 percent slopes	15	7	45	VIIe
CpF	Coyata rocky loam, dissected, 60 to 80 percent slopes	15	7	45	VIIe
CrC	Crater Lake fine sandy loam, 0 to 20 percent slopes	16	2	43	VIe
CsD	Crater Lake-Snowlin complex, 10 to 30 percent slopes	16	2	43	VIe
DeD	Deatman gravelly loam, 20 to 40 percent slopes	17	10	46	VIIe
DrE	Deatman rocky loam, 40 to 60 percent slopes	17	10	46	VIIe
DsE	Deatman rocky loam, dissected, 40 to 80 percent slopes	17	10	46	VIIe
DtF	Deatman very rocky loam, 60 to 80 percent slopes	16	10	46	VIIs
DuC	Dumont gravelly loam, 0 to 20 percent slopes	19	2	43	VIe
DuD	Dumont gravelly loam, 20 to 40 percent slopes	17	2	43	VIe
DuE	Dumont gravelly loam, 40 to 60 percent slopes	19	5	44	VIIe
FsC	Fives loam, 0 to 20 percent slopes	21	2	43	VIe
FsD	Fives loam, 20 to 40 percent slopes	20	2	43	VIe
FsE	Fives loam, 40 to 60 percent slopes	21	5	44	VIIe
FtD	Fives clay, dark variant, 5 to 30 percent slopes	21	11	46	VIe
FvC	Freezener gravelly loam, 0 to 20 percent slopes	22	1	43	VIe
FvD	Freezener gravelly loam, 20 to 40 percent slopes	22	1	43	VIe
FvE	Freezener gravelly loam, 40 to 60 percent slopes	23	6	45	VIIe
FzD	Freezener clay loam, heavy variant, 20 to 40 percent slopes	23	8	45	VIe
GuD	Gustin loam, 0 to 30 percent slopes	23	8	45	VIe
HbD	Hummington gravelly loam, 20 to 40 percent slopes	25	3	43	VIe
HbE	Hummington gravelly loam, 40 to 60 percent slopes	25	5	44	VIIe
HrF	Hummington rocky loam, 60 to 80 percent slopes	25	7	45	VIIe
HuF	Hummington rocky loam, dissected, 60 to 80 percent slopes	25	7	45	VIIe
La	Landslide, Acker materials	25	4	44	VIe
Lb	Landslide, Boze materials	25	4	44	VIe
Ld	Landslide, Dumont materials	26	4	44	VIe
Le	Landslide, Fives materials	26	4	44	VIe
Lf	Landslide, Freezener materials	26	4	44	VIe
Lg	Landslide, Gustin materials	26	4	44	VIe
Lz	Landslide, Zing materials	26	4	44	VIe
PgD	Prong gravelly loam, 20 to 40 percent slopes	27	9	45	VIIe
PgE	Prong gravelly loam, 40 to 60 percent slopes	27	9	45	VIIe
PgF	Prong gravelly loam, 60 to 80 percent slopes	26	10	46	VIIe
PoF	Prong gravelly loam, dissected, 60 to 80 percent slopes	27	10	46	VIIe
PrF	Prong rocky loam, 80 to 100 percent slopes	27	10	46	VIIe
SnC	Snowlin gravelly loam, 0 to 20 percent slopes	28	1	43	VIe
SnD	Snowlin gravelly loam, 20 to 40 percent slopes	27	1	43	VIe
SnE	Snowlin gravelly loam, 40 to 60 percent slopes	28	6	45	VIIe
StD	Straight gravelly loam, 20 to 40 percent slopes	29	9	45	VIIe
StE	Straight gravelly loam, 40 to 60 percent slopes	28	9	45	VIIe

Map symbol	Mapping unit	Described on page	Soil management group		Capability subclass
			Number	Page	
StF	Straight gravelly loam, 60 to 80 percent slopes	29	10	46	VIIe
SuF	Straight gravelly loam, dissected, 60 to 80 percent slopes	29	10	46	VIIe
Tv	Tuff rock land	29	11	46	VIIIs
VeE	Vena gravelly loam, 40 to 60 percent slopes	29	10	46	VIIe
VrE	Vena very rocky loam, 20 to 60 percent slopes	29	10	46	VIIs
VrF	Vena very rocky loam, 60 to 80 percent slopes	29	10	46	VIIs
VrG	Vena very rocky loam, 80 to 100 percent slopes	30	10	46	VIIs
VvF	Vena very rocky loam, dissected, 60 to 80 percent slopes	30	10	46	VIIs
WhC	Whitehorse loam, 0 to 20 percent slopes	31	11	46	VIe
WhD	Whitehorse loam, 20 to 40 percent slopes	31	11	46	VIe
ZgC	Zing loam, 0 to 20 percent slopes	31	8	45	VIe

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U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
FOREST SERVICE

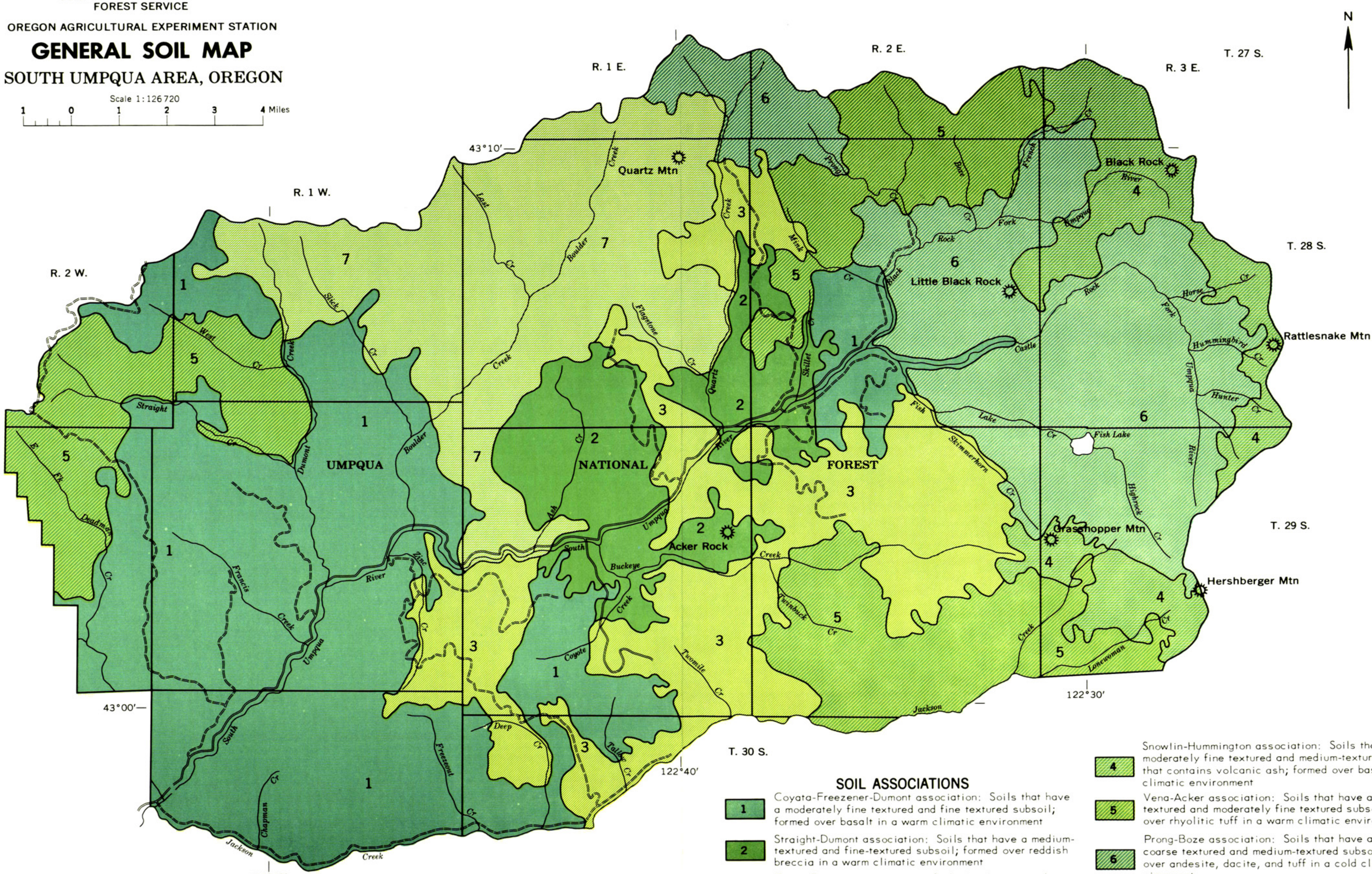
OREGON AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP

SOUTH UMPQUA AREA, OREGON

Scale 1:126 720

1 0 1 2 3 4 Miles



SOIL ASSOCIATIONS

1 Coyata-Freezener-Dumont association: Soils that have a moderately fine textured and fine textured subsoil; formed over basalt in a warm climatic environment

2 Straight-Dumont association: Soils that have a medium-textured and fine-textured subsoil; formed over reddish breccia in a warm climatic environment

3 Fives-Deatman association: Soils that have a moderately fine textured subsoil; formed over greenish breccia in a warm climatic environment

4 Snowlin-Hummington association: Soils that have a moderately fine textured and medium-textured subsoil that contains volcanic ash; formed over basalt in a cold climatic environment

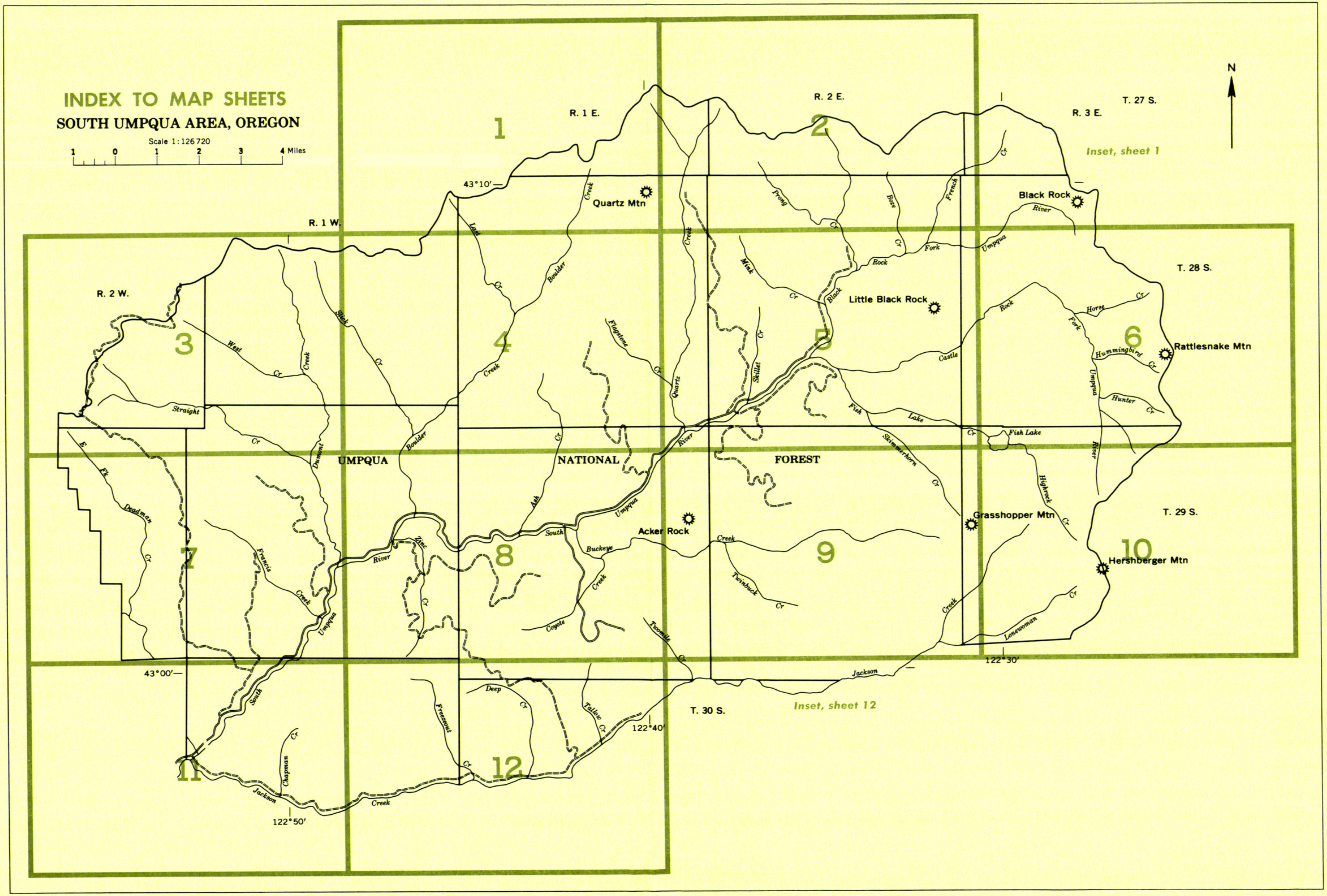
5 Vena-Acker association: Soils that have a medium-textured and moderately fine textured subsoil; formed over rhyolitic tuff in a warm climatic environment

6 Prong-Boze association: Soils that have a moderately coarse textured and medium-textured subsoil; formed over andesite, dacite, and tuff in a cold climatic environment

7 Vena association: Soils less than 40 inches thick that have a medium-textured subsoil; formed over rhyolitic tuff in a warm climatic environment

Published 1972

This map is for general planning. It shows only the major soils and does not contain sufficient detail for operational planning.



INDEX TO MAP SHEETS
SOUTH UMPQUA AREA, OREGON
Scale 1:126 720
1 0 1 2 3 4 Miles
N
R. 2 W.
R. 1 W.
R. 1 E.
R. 2 E.
R. 3 E.
T. 27 S.
T. 28 S.
T. 29 S.
T. 30 S.
43°10′
43°00′
122°50′
122°40′
122°30′
Inset, sheet 1
Inset, sheet 12
UMPQUA
NATIONAL
FOREST
Quartz Mtn
Black Rock
Little Black Rock
Rattlesnake Mtn
Acker Rock
Grasshopper Mtn
Hershberger Mtn
Fish Lake
1
2
3
4
5
6
7
8
9
10
11
12

CONVENTIONAL SIGNS

WORKS AND STRUCTURES

Highways and roads
- Dual
- Good motor
- Poor motor
- Trail

Highway markers
- National Interstate
- U. S.
- State or county

Railroads
- Single track
- Multiple track
- Abandoned

Bridges and crossings
- Road
- Trail
- Railroad
- Ferry (FY)
- Ford (FORD)
- Grade
- R. R. over
- R. R. under

Tunnel

Buildings
- School
- Church

Mine and quarry

Gravel pit

Power line

Pipeline

Cemetery

Dams

Levee

Tanks

Well, oil or gas

Forest fire or lookout station

Windmill

BOUNDARIES

- National or state
- County
- Area boundary
- Reservation
- Land grant
- Small park, cemetery, airport

DRAINAGE

Streams, double-line
- Perennial
- Intermittent

Streams, single-line
- Perennial
- Intermittent
  - Crossable with tillage implements
  - Not crossable with tillage implements
  - Unclassified

Canals and ditches (CANAL)

Lakes and ponds
- Perennial (water, w)
- Intermittent (int)

Spring

Marsh or swamp

Wet spot

Alluvial fan

Drainage end

RELIEF

Escarpments
- Bedrock
- Other

Prominent peak

Depressions (Large, Small)
- Crossable with tillage implements
- Not crossable with tillage implements
- Contains water most of the time

SOIL SURVEY DATA

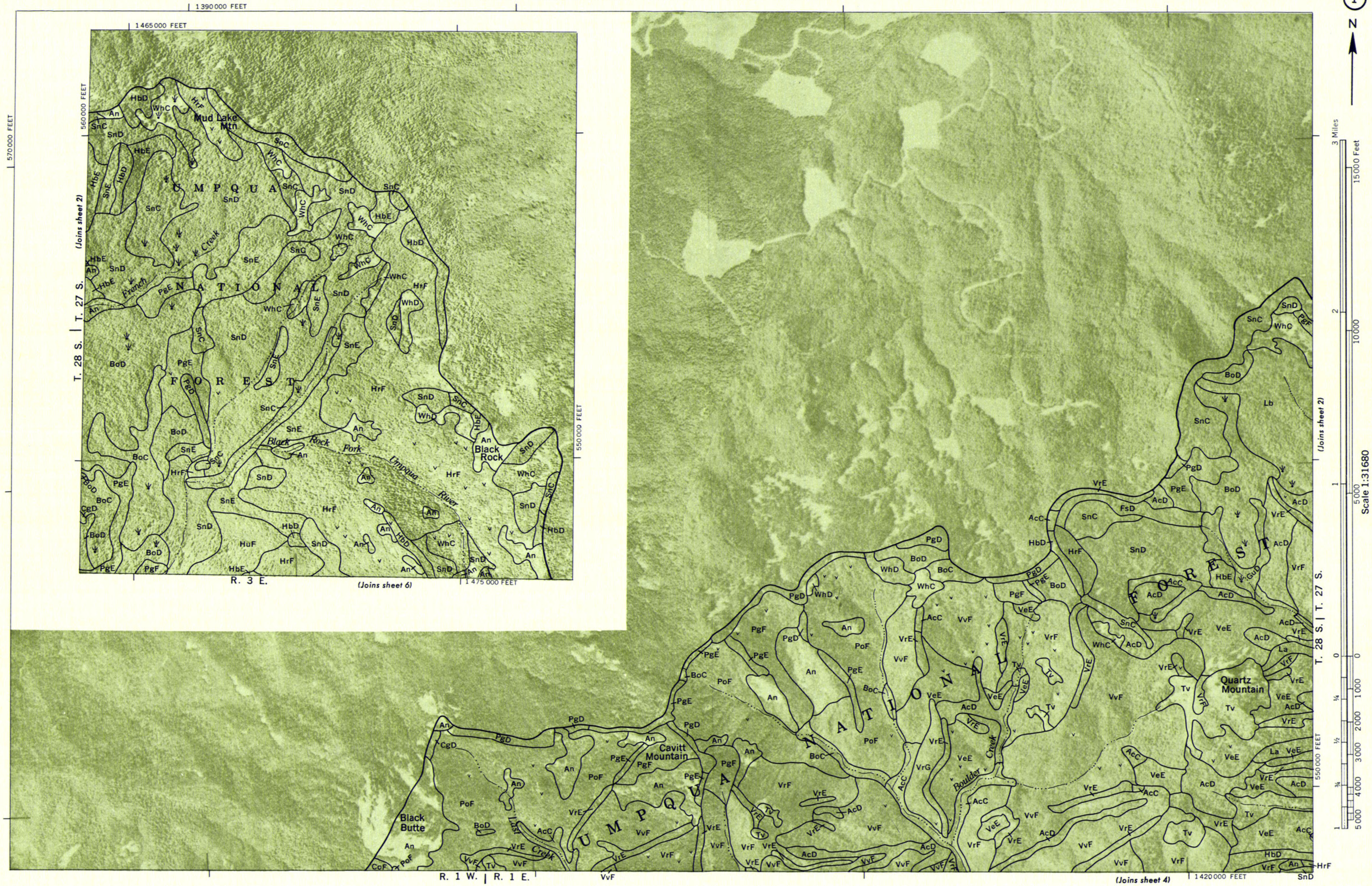
- Soil boundary and symbol (Dx)
- Gravel
- Stoniness: Stony; Very stony
- Rock outcrops
- Chert fragments
- Clay spot
- Sand spot
- Gumbo or scabby spot
- Made land
- Severely eroded spot
- Blowout, wind erosion
- Gully
- Landslide or slip

SOIL LEGEND

Each symbol consists of two or three letters; for example An, BoC, CgD, CgE, HrF, VrG. The second capital letter shows the class of slope.

SYMBOL	NAME
AcC	Acker gravelly loam, 0 to 20 percent slopes
AcD	Acker gravelly loam, 20 to 40 percent slopes
AcE	Acker gravelly loam, 40 to 60 percent slopes
Al	Alluvial land
An	Andesite rock land
BoC	Boze gravelly loam, 0 to 20 percent slopes
BoD	Boze gravelly loam, 20 to 40 percent slopes
CgD	Coyata gravelly loam, 20 to 40 percent slopes
CgE	Coyata gravelly loam, 40 to 60 percent slopes
CoF	Coyata rocky loam, 60 to 80 percent slopes
CpF	Coyata rocky loam, dissected, 60 to 80 percent slopes
CrC	Crater Lake fine sandy loam, 0 to 20 percent slopes
CsD	Crater Lake-Snowlin complex, 10 to 30 percent slopes
DeD	Deatman gravelly loam, 20 to 40 percent slopes
DrE	Deatman rocky loam, 40 to 60 percent slopes
DsE	Deatman rocky loam, dissected, 40 to 80 percent slopes
DtF	Deatman very rocky loam, 60 to 80 percent slopes
DuC	Dumont gravelly loam, 0 to 20 percent slopes
DuD	Dumont gravelly loam, 20 to 40 percent slopes
DuE	Dumont gravelly loam, 40 to 60 percent slopes
FsC	Fives loam, 0 to 20 percent slopes
FsD	Fives loam, 20 to 40 percent slopes
FsE	Fives loam, 40 to 60 percent slopes
FtD	Fives clay, dark variant, 5 to 30 percent slopes
FvC	Freezener gravelly loam, 0 to 20 percent slopes
FvD	Freezener gravelly loam, 20 to 40 percent slopes
FvE	Freezener gravelly loam, 40 to 60 percent slopes
FzD	Freezener clay loam, heavy variant, 20 to 40 percent slopes
GuD	Gustin loam, 0 to 30 percent slopes
HbD	Hummington gravelly loam, 20 to 40 percent slopes
HbE	Hummington gravelly loam, 40 to 60 percent slopes
HrF	Hummington rocky loam, 60 to 80 percent slopes
HuF	Hummington rocky loam, dissected, 60 to 80 percent slopes
La	Landslide, Acker materials
Lb	Landslide, Boze materials
Ld	Landslide, Dumont materials
Le	Landslide, Fives materials
Lf	Landslide, Freezener materials
Lg	Landslide, Gustin materials
Lz	Landslide, Zing materials
PgD	Prong gravelly loam, 20 to 40 percent slopes
PgE	Prong gravelly loam, 40 to 60 percent slopes
PgF	Prong gravelly loam, 60 to 80 percent slopes
PoF	Prong gravelly loam, dissected, 60 to 80 percent slopes
PrF	Prong rocky loam, 80 to 100 percent slopes
SnC	Snowlin gravelly loam, 0 to 20 percent slopes
SnD	Snowlin gravelly loam, 20 to 40 percent slopes
SnE	Snowlin gravelly loam, 40 to 60 percent slopes
StD	Straight gravelly loam, 20 to 40 percent slopes
StE	Straight gravelly loam, 40 to 60 percent slopes
StF	Straight gravelly loam, 60 to 80 percent slopes
SuF	Straight gravelly loam, dissected, 60 to 80 percent slopes
Tv	Tuff rock land
VeE	Vena gravelly loam, 40 to 60 percent slopes
VrE	Vena very rocky loam, 20 to 60 percent slopes
VrF	Vena very rocky loam, 60 to 80 percent slopes
VrG	Vena very rocky loam, 80 to 100 percent slopes
VvF	Vena very rocky loam, dissected, 60 to 80 percent slopes
WhC	Whitehorse loam, 0 to 20 percent slopes
WhD	Whitehorse loam, 20 to 40 percent slopes
ZgC	Zing loam, 0 to 20 percent slopes

1



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SOUTH UMPQUA AREA, OREGON NO. 1

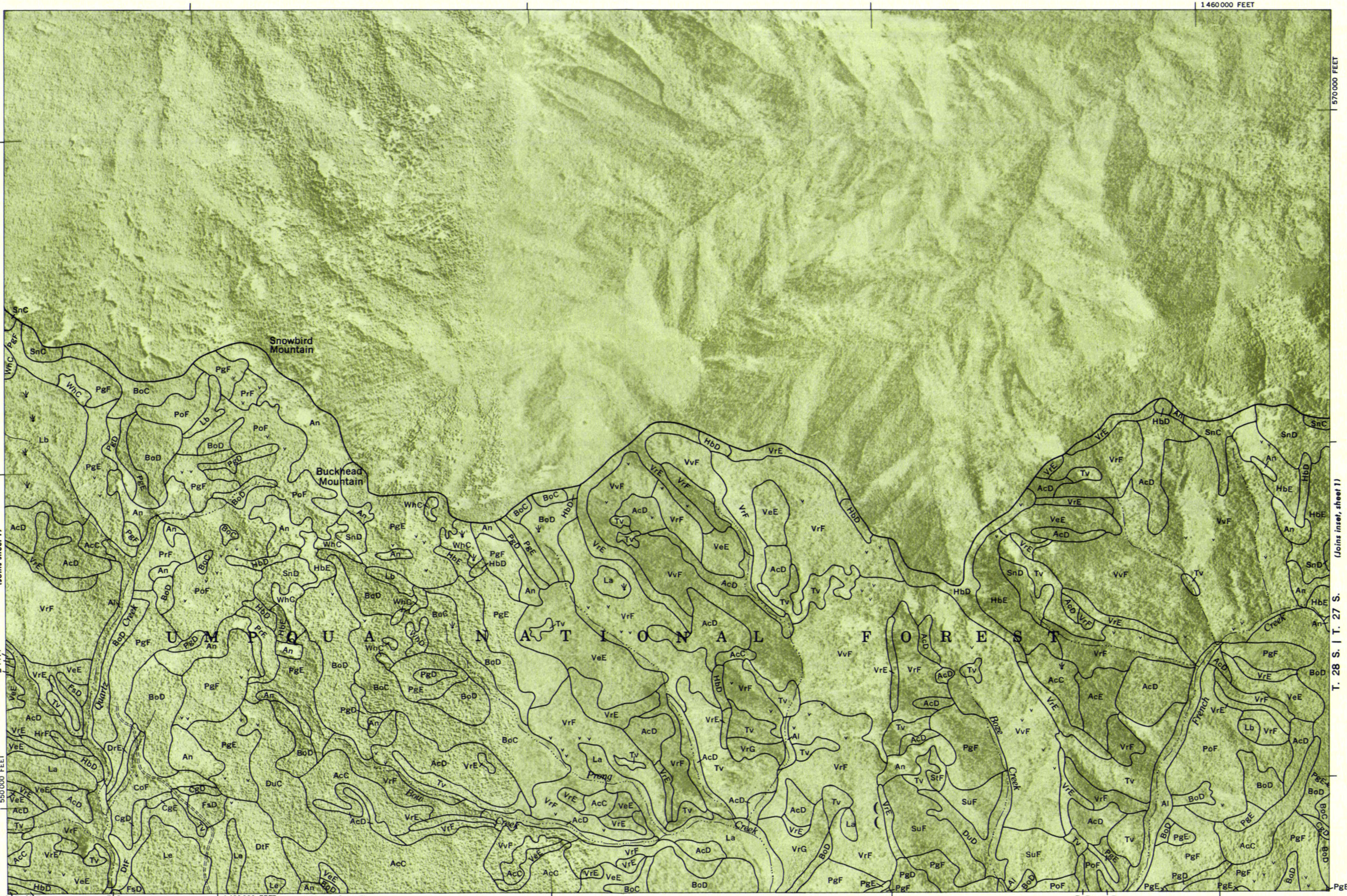
SOUTH UMPQUA AREA, OREGON — SHEET NUMBER 2

N

Scale 1:31680

3 Miles · 2 · 1 · 0 · ¼ · ½ · ¾ · 1

15000 Feet · 10000 · 5000 · 0 · 1000 · 2000 · 3000 · 4000 · 5000



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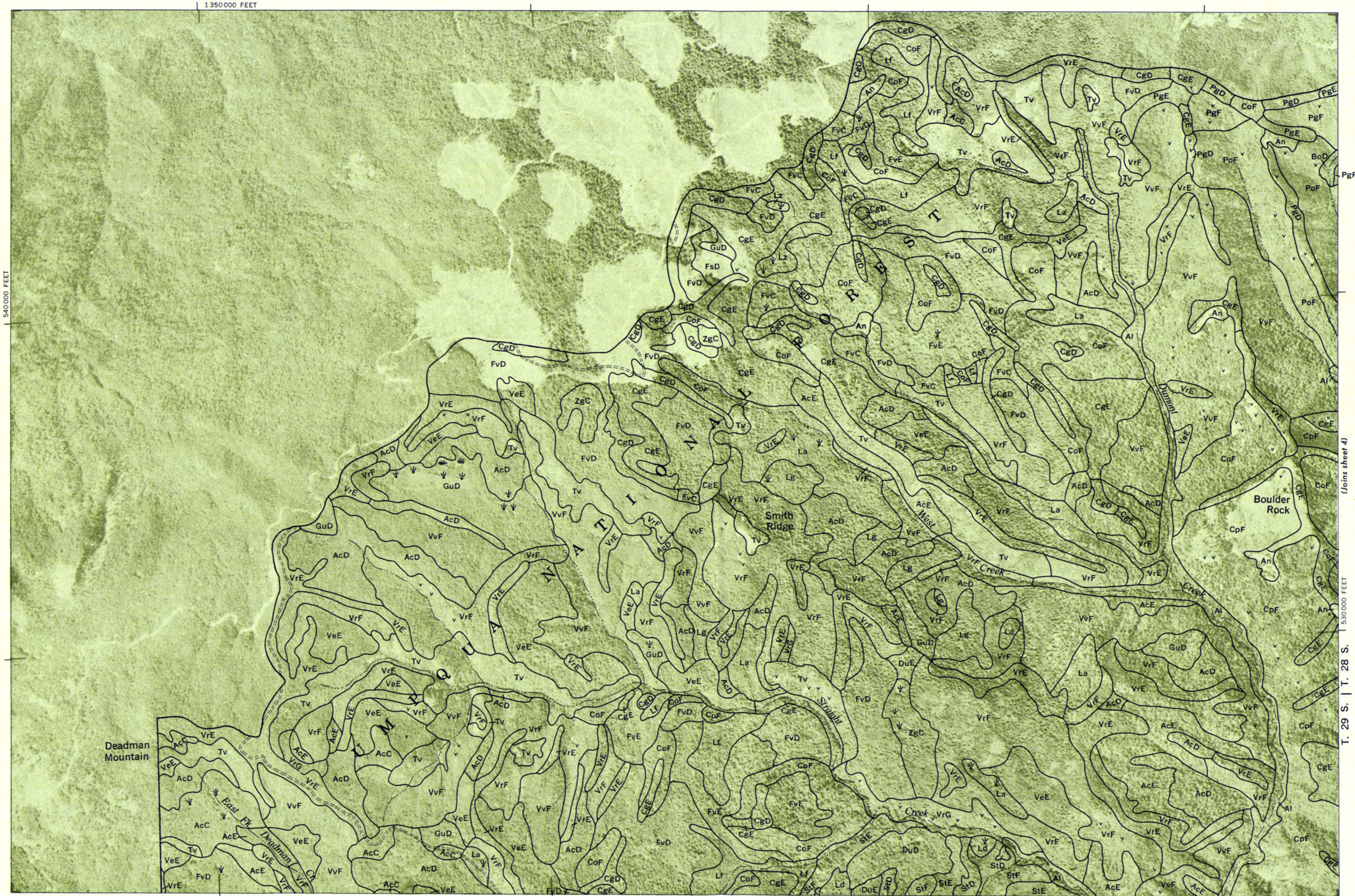

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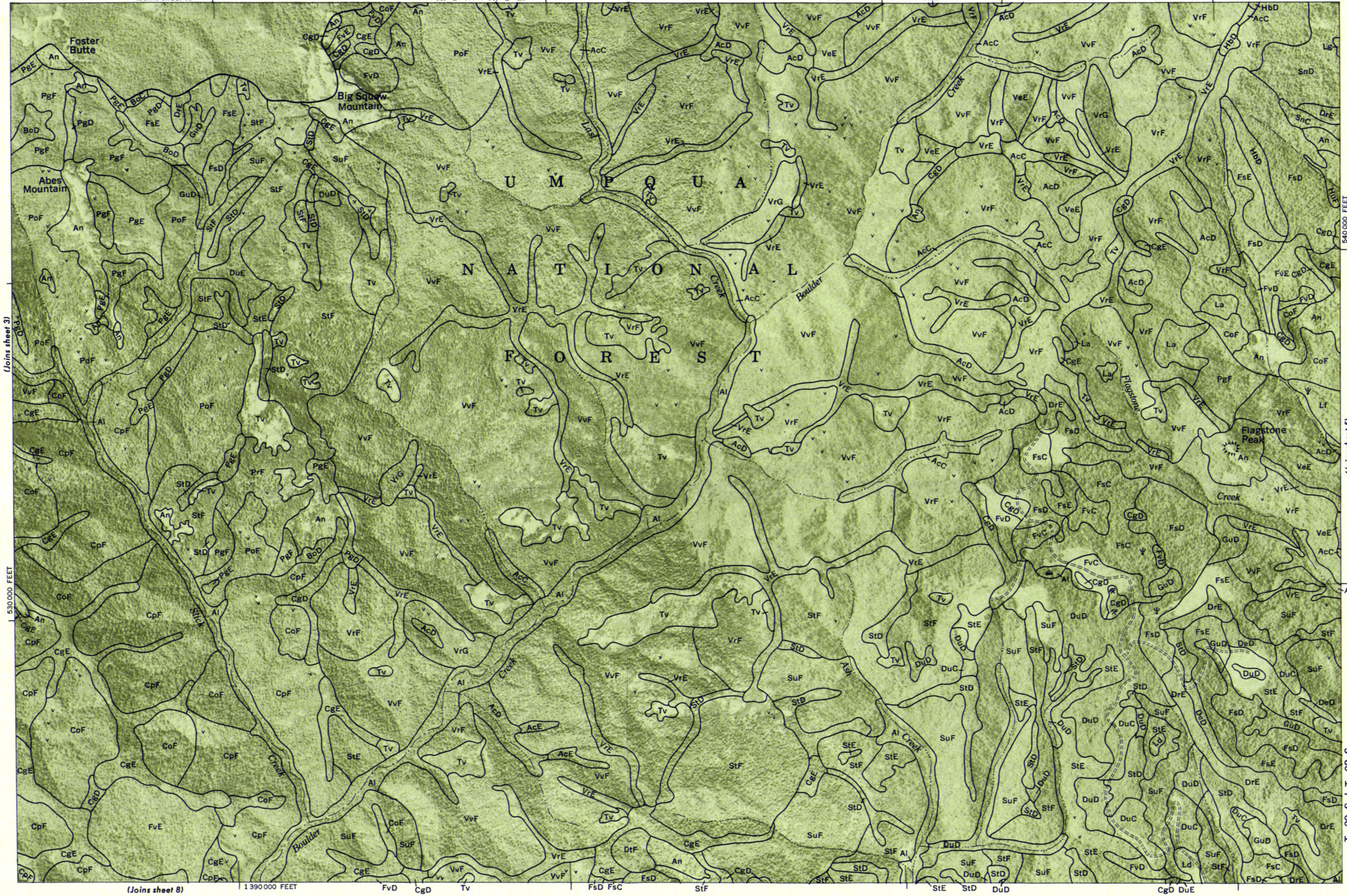
4

SOUTH UMPQUA AREA, OREGON — SHEET NUMBER 4



N

Scale 1:31680

3 Miles 2 1 0 ¼ ½ ¾ 1

15000 Feet 10000 5000 0 1000 2000 3000 4000 5000

SOUTH UMPQUA AREA, OREGON NO. 4

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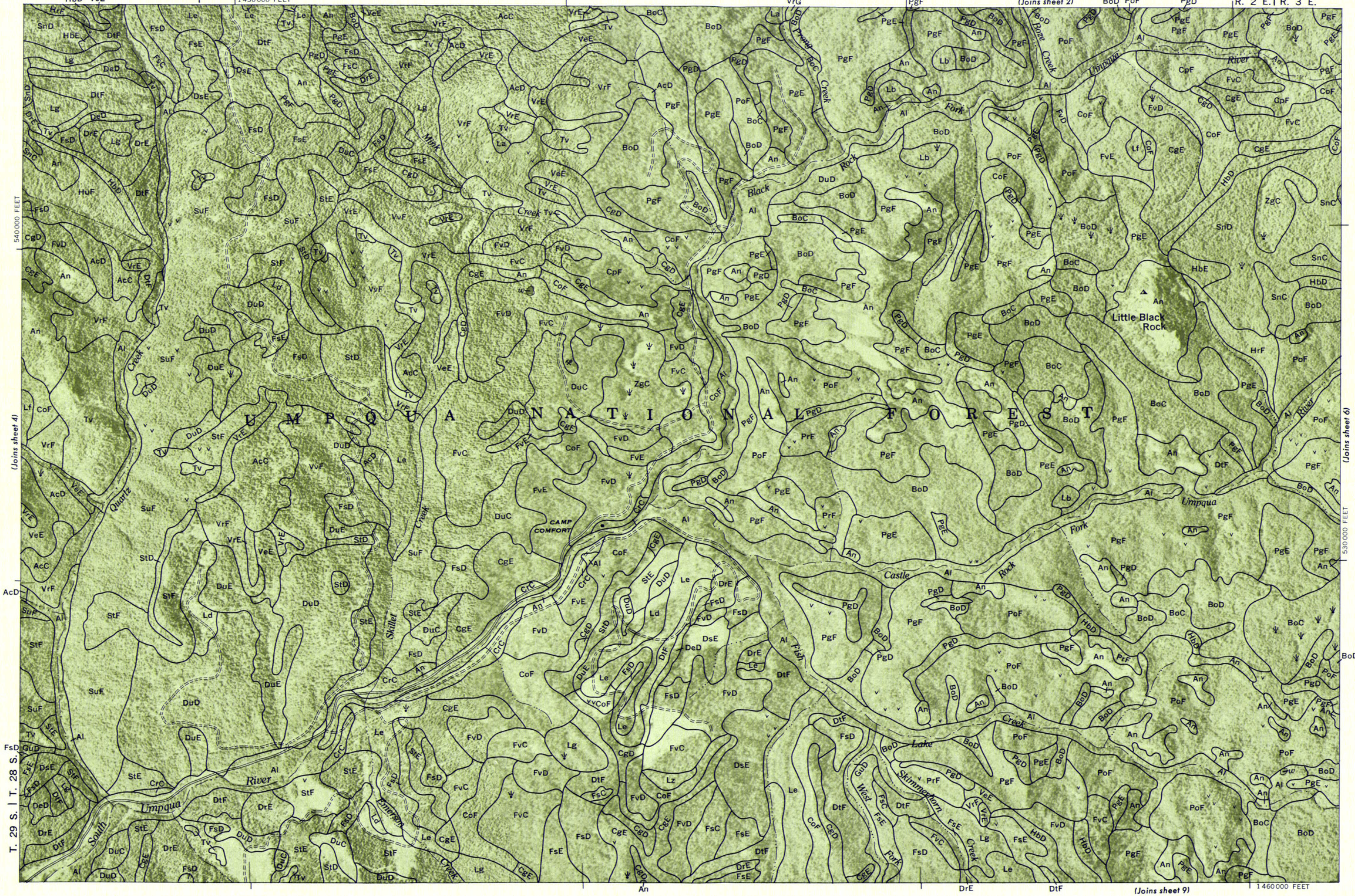
5



N

Scale 1:31680

3 Miles, 2, 1, ½, ¼, 0

15000 Feet, 10000, 5000, 0, 1000, 2000, 3000, 4000, 5000

SOUTH UMPQUA AREA, OREGON NO. 5

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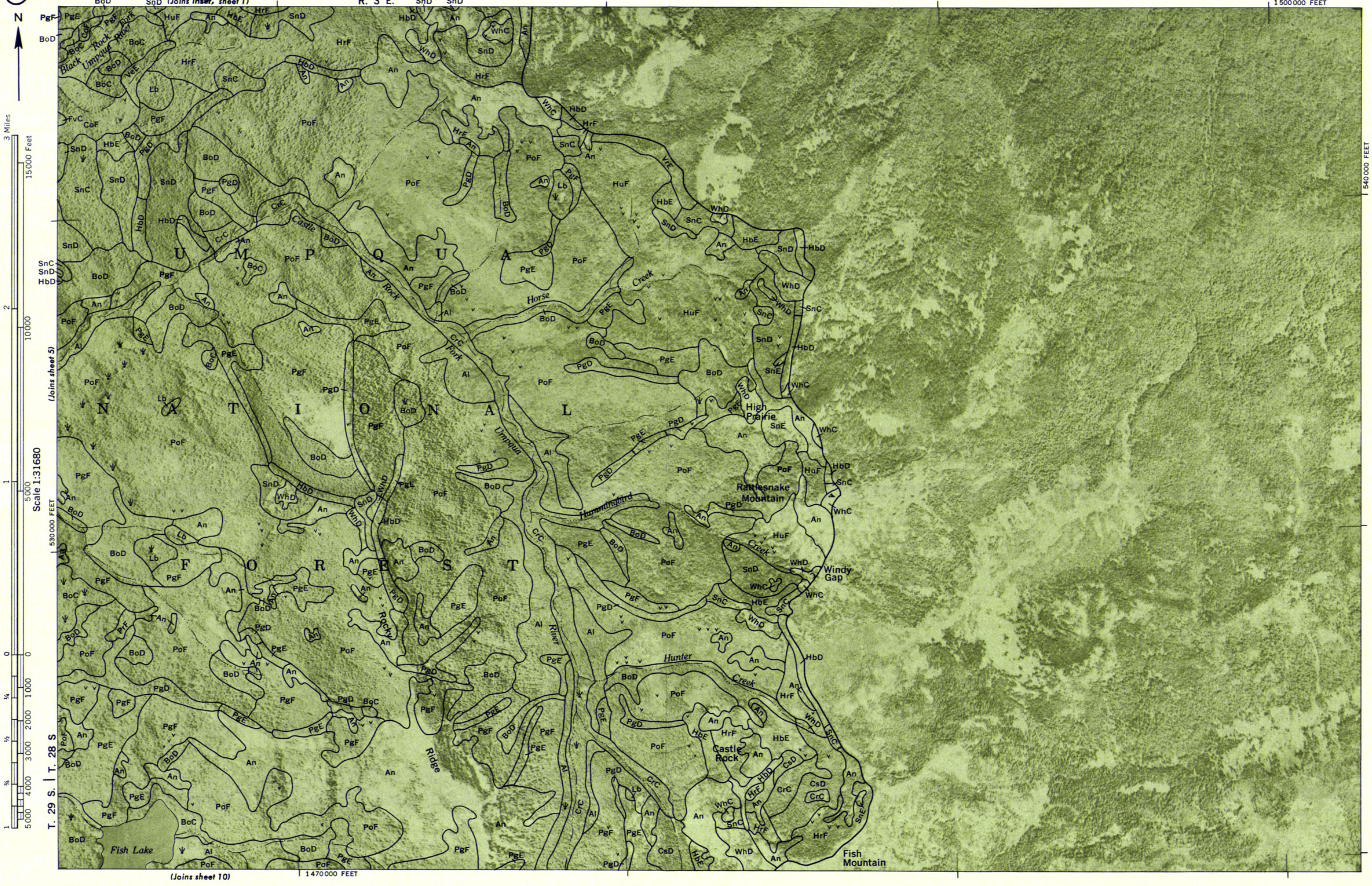
SOUTH UMPQUA AREA, OREGON — SHEET NUMBER 6



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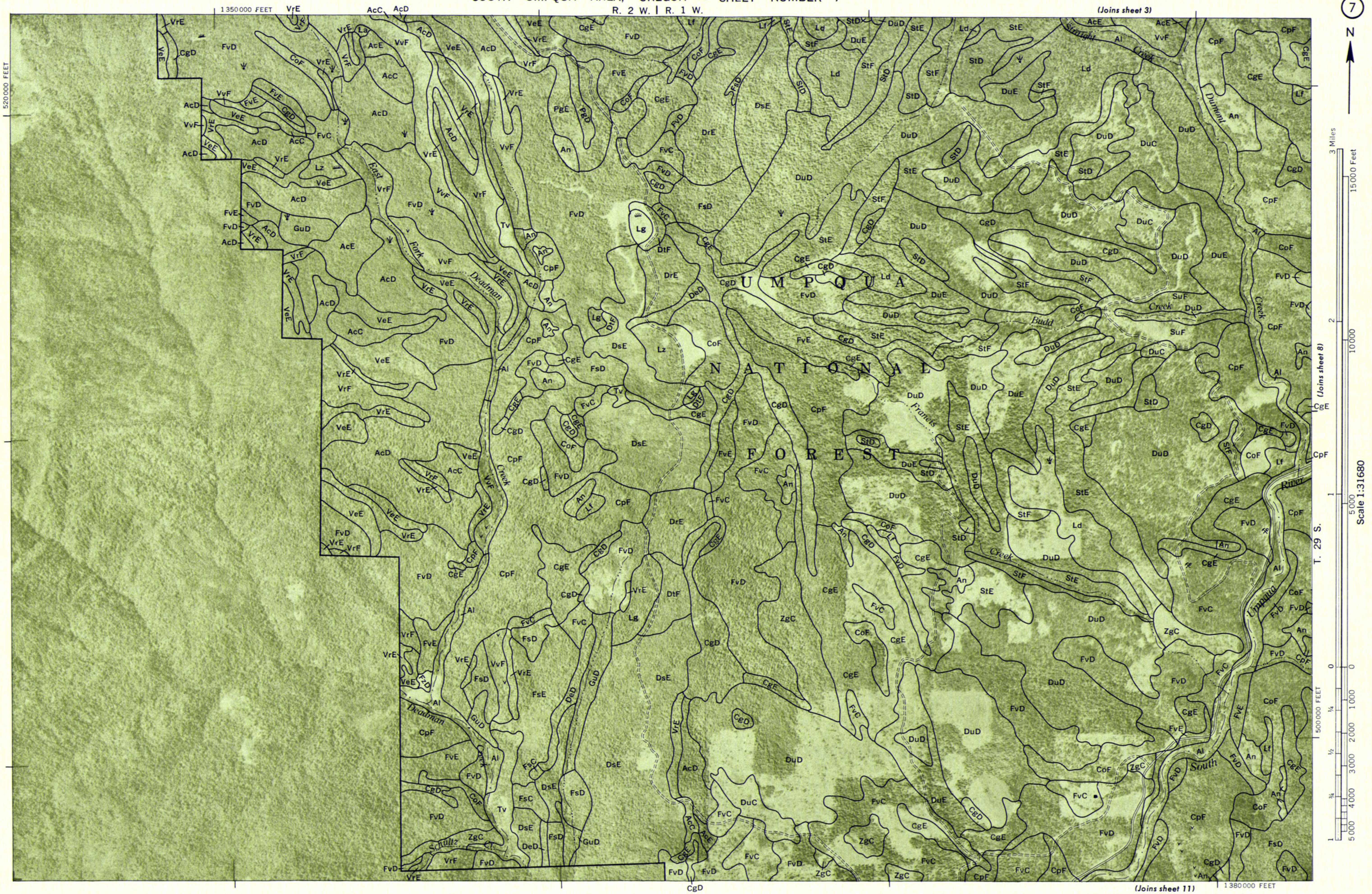
SOUTH UMPQUA AREA, OREGON — SHEET NUMBER 7



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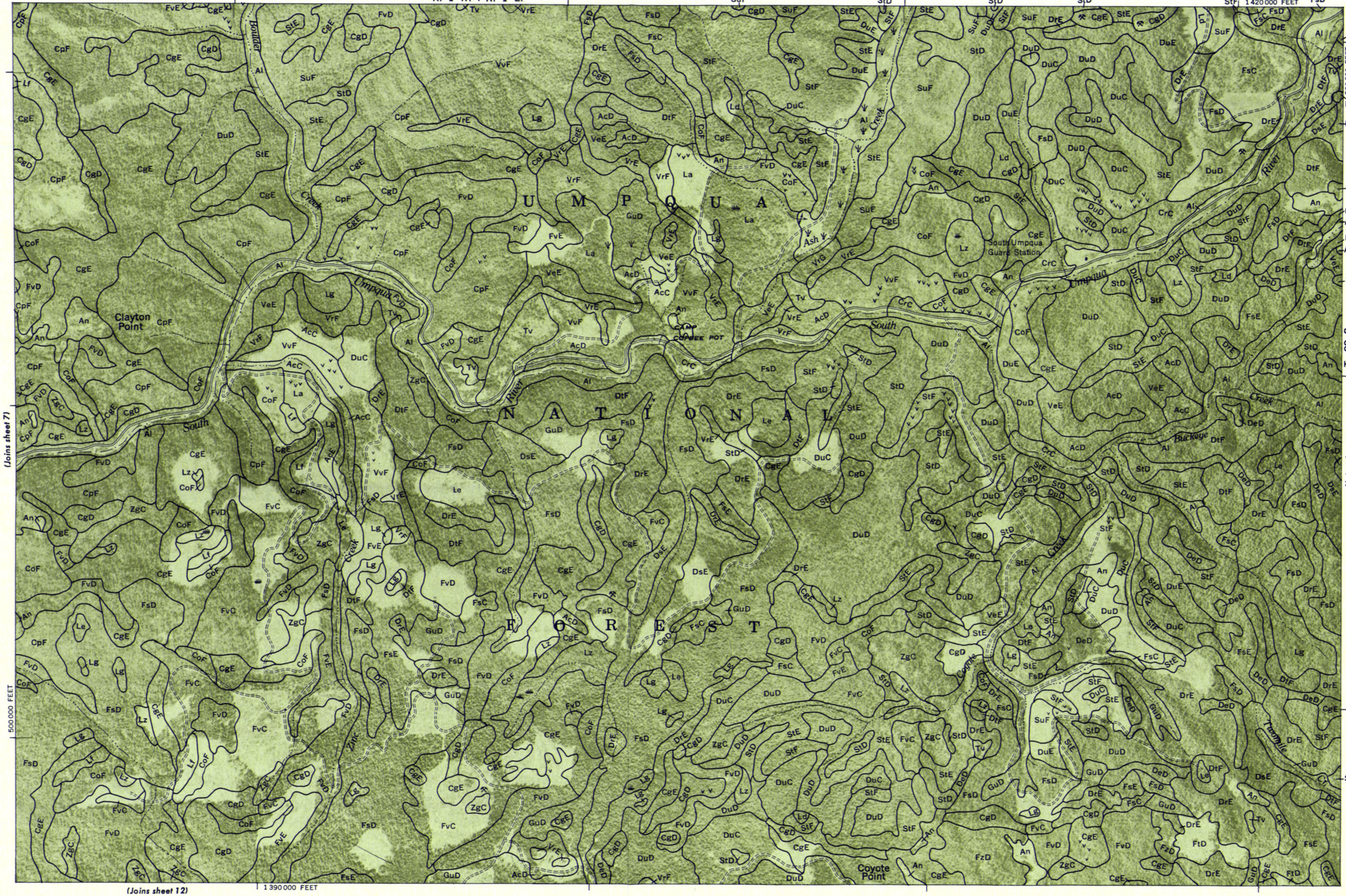
SOUTH UMPQUA AREA, OREGON NO. 7

SOUTH UMPQUA AREA, OREGON — SHEET NUMBER 8

(Joins sheet 4)

R. 1 W. | R. 1 E.



(Joins sheet 12)

N

Scale 1:31680

3 Miles | 2 | 1 | 0 | ¼ | ½ | ¾ | 1

15 000 Feet | 10 000 | 5000 | 0 | 1000 | 2000 | 3000 | 4000 | 5000

SOUTH UMPQUA AREA, OREGON NO. 8

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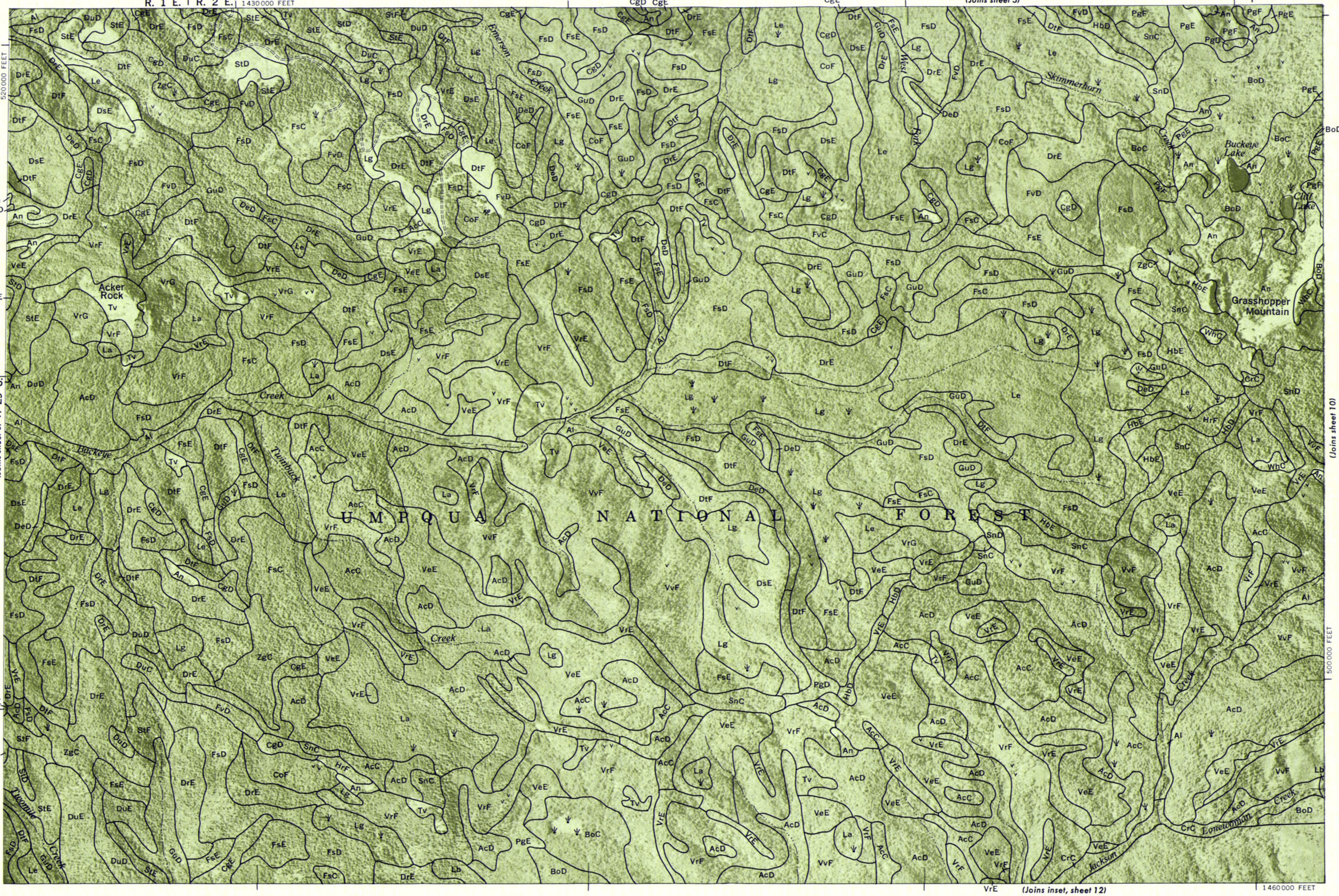

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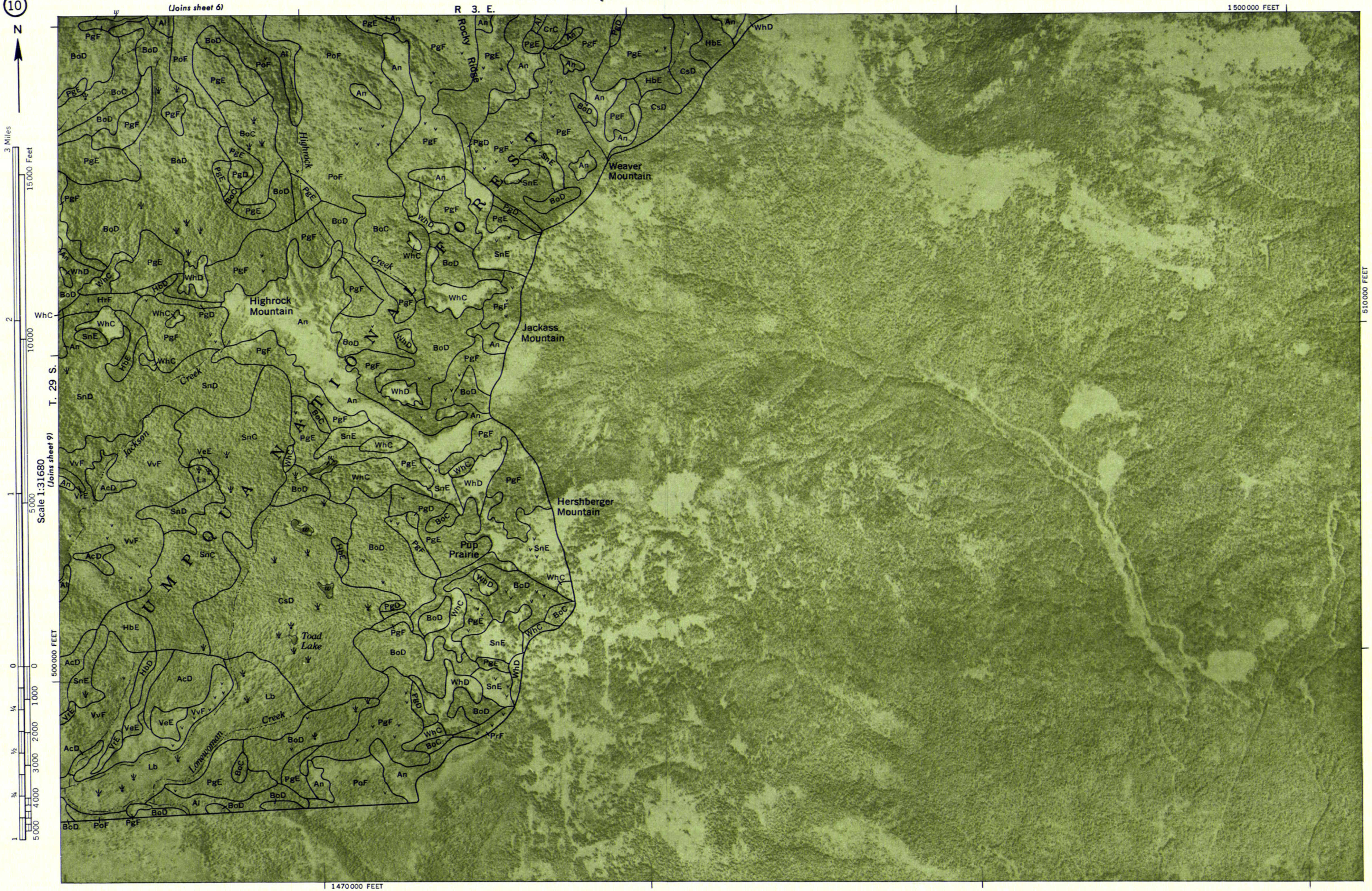
SOUTH UMPQUA AREA, OREGON NO. 9



SOUTH UMPQUA AREA, OREGON NO. 10

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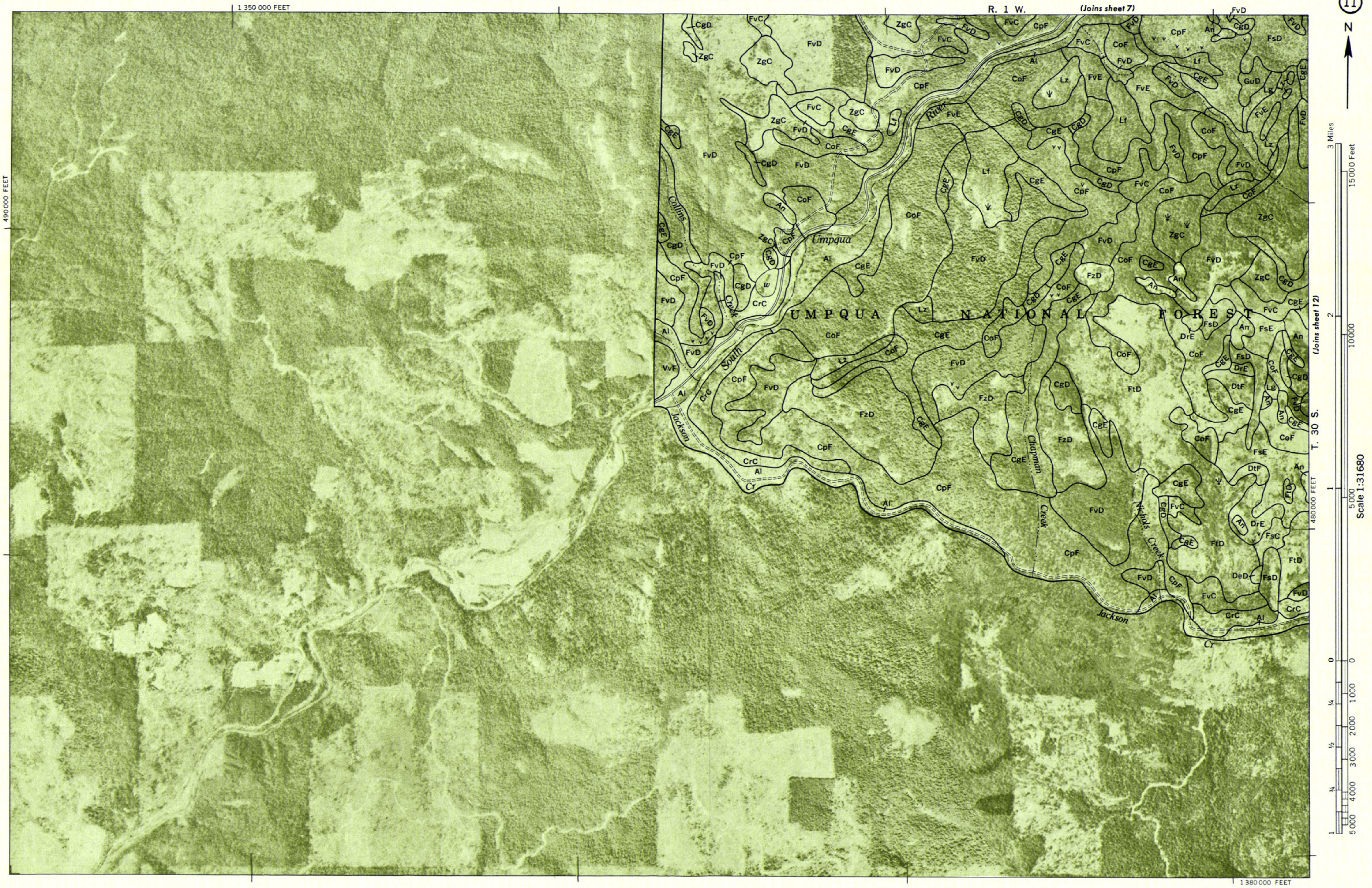

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SOUTH UMPQUA AREA, OREGON — SHEET NUMBER 12

SOUTH UMPQUA AREA, OREGON NO. 12

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